

SECTION 18 – BRIDGE SEISMIC RETROFIT AND STRENGTHENING

INTRODUCTION

The purpose of a Seismic Retrofit project is to modify a bridge to survive a seismic event that could otherwise cause it to fail catastrophically. A Bridge Strengthening project is designed to increase the “Permit Load” of a given structure, usually steel. This is the maximum vehicular load the structure is allowed to carry without potential damage. Bridge Strengthening and Retrofits use three types of materials: reinforced concrete, structural steel and composites. These additions could be as simple as bearing seat extensions, cable restrainers, column wraps and shear keys, to the more complex work of adding piles to existing abutment or bent foundations. It is possible to have retrofit/strengthening work occurring concurrently on the same steel structure.

Memo to Designers 20-4 “SEISMIC RETROFIT GUIDELINES FOR BRIDGES IN CALIFORNIA” provides requirements and guidelines for bridge seismic retrofitting policies and procedures used by Caltrans. Bridge Design Aids Section 14-5 “EXAMPLE SEISMIC RETROFIT DETAILS” was created to support those guidelines with basic details. However, these examples are intended for illustration purposes only and significant modification may be required for them to be applied to a specific structure.

The detailer will need to create current as-built base drawings that reflect all modifications to the structure, to truthfully illustrate the existing bridge as it is today.

There are two ways to do this:

1. Access the BIRIS System to retrieve “as-built” plans you can use to draw dimensionally correct base details for your bridge. For bridges with steel superstructures, look for “Shop Plans”. These are highly detailed fabrication drawings that dimension and locate every piece of steel used.
2. You can use existing Microstation .dgn drawings of your project bridge, if available, from the Falcon Document Management System. These may need to be adjusted to suit your current circumstance; levels, line fonts, weights and colors. Verify the drawing accuracy. If the Microstation source .dgns are not AS-BUILT records, you will need to update them based on Biris System As-builts. If updates are necessary, you will still see significant time saving over starting from scratch. Check existing details for compliance with current practices and standards.

Strengthening and Retrofit details will be applied to most of the existing plan types, Abutments, Bents, Typical Sections, Girder Layouts and related Sections/Elevations. Refer to these sections of BRIDGE DESIGN DETAILS as required. Drawing scale plays an important role in modification detailing. The detailer must determine what scale gives the best results. Look at the smallest item to be shown, usually fasteners, to determine what depth of detail is required. It may not be necessary to show fully detailed bolts/nuts when a hole or a drill-point symbol can suffice. In some cases, the Engineer may want to show the “Grip” dimension of bolts shown in section. See BDD 18 Figure 18-11.4. Dimensioning may control scale, so be aware of minimum dimensions to be shown.

The detail examples that follow show retrofit strategies that have been used previously. However, these details are not meant to limit the creativity of the designer or detailer. Each bridge retrofit is potentially unique, as the examples of past retrofits will demonstrate.

HISTORY

The 1971 San Fernando earthquake was one of the most important in the development of modern seismic design and retrofitting practices for bridges. This Magnitude 6.7 earthquake of February 9, 1971 at 6:07 am caused 53 deaths and an estimated damage of nearly \$1 billion in 1971 dollars.

The Loma Prieta earthquake of October 17, 1989 at 5:04 pm, pacific daylight time, occurred near three large modern cities-San Jose, San Francisco and Oakland. This Magnitude 7.1 earthquake was felt from Los Angeles north to the Oregon State line, and east to western Nevada. It was the largest to occur in the San Francisco Bay area since the great San Francisco earthquake of 1906.

The Northridge earthquake of January 17, 1994, occurred at 4:31 am and resulted in about 65 deaths and over 5,000 injuries. This magnitude 6.7 earthquake strongly affected the northern parts of Los Angeles and the San Fernando Valley and surrounding areas in southern California. It was the most costly single natural disaster in the history of the United States. Damage estimates are in the range of \$20 billion. This earthquake caused serious damage and failures to critical transportation systems, widespread disruption of utilities and other lifelines.

Future earthquakes in California are inevitable. They represent a clear and continuing danger to our population and economy. Every Californian is affected by the occurrence of a major earthquake, whether expressed as direct damage, indirect loss of utilities, increased taxation, or reduced economic activity. Recent scientific research tells us that there is a high probability of a major earthquake in both Southern and Northern California.

The earthquakes above and others, caused the development of, and continue to drive the most ambitious public safety program ever devised.

Caltrans and The Office of Earthquake Engineering are dedicated to protecting the traveling public by providing new bridge design and retrofit practices that are 'state-of-the-art'. The following details and examples will give the Structural Design Technician the guidance to produce clear and concise retrofit contract plans.

GUIDELINES FOR SEISMIC RETROFITS

18.1.0 GENERAL PLAN See “GENERAL PLAN” Section 3 of Bridge Design Details.

The “GENERAL PLAN” is the sheet where all retrofit locations and types are shown. There is a ‘Legend’ with symbols defining the various types. It may be difficult to show any significant level of detail on the ‘PLAN VIEW’ as most retrofit work is done inside the cells of the superstructure, which requires the use of dashed line-work. The ‘ELEVATION’ view is the choice for most of the work pertaining to the columns or footings. The ‘TYPICAL SECTION’ should be taken in an advantageous location to aid in showing the most information possible, but this may cause the ‘TYPICAL SECTION’ to be less typical and more specific. If this is the case, use a section-cut identifier to locate the section and label accordingly.

There are many configurations and combinations of retrofit methods. Depending on scale, these could be shown as simple graphic representations, or symbols that refer back to a ‘LEGEND’ for a verbal description. Generally a retrofit project doesn’t change the ‘foot-print’ of a bridge unless there are foundation modifications. However, there is the ultimate retrofit, a total bridge replacement based on seismic criteria. Engineers have done detailed analysis and have deemed the existing structure is too costly to bring up to current seismic standards by retrofit. The project may become a ‘replace’ or new structure, using stage construction practices. For ‘GENERAL PLAN’ examples see, BDD Figure 18-3.1 and 3.2.

There may be additional work on the bridge deck. This work could include adding manholes for permanent access to the interior of the structure, joint seal work, barrier rail up-grades, overlays, etc. This would create a need for lane shifts or closures. The District will provide traffic handling plans. Check with your designer for the location of Temporary Railing, (TYPE K), for more information on the use of Temporary Railing, (TYPE K), see BDD 17.1.0 and Figure 17-13 and 17-15.

18.1.1 DEPENDENT DIMENSION AND USE OF THE PLUS/MINUS SYMBOL

The following is excerpted from MEMOS TO DESIGNERS 9-1:

“Whenever work entails modifications of an existing structure or is tied to an existing structure for layout, it is important to account for possible dimensional discrepancies between the actual existing structure and the as-built plans for that structure.

To accomplish this, all dimensions of the new work that are dependent on the dimensions of the existing structure (dimensions which tie to any feature of the existing structure) shall be indicated as approximate by the addition of a \pm (plus/minus symbol) following that dependent dimension. The dependent dimensions shown on the plans must be sufficient to enable quantity calculations for both PS&E and bidding purposes and must reflect the accuracy to which the dimensions of the existing structure are known. However, the Contractor must be made responsible for field measuring the existing structure before commencing work. The Microstation cell “verify” from the most current release of the “stcel.cel” (US Customary Units) library shall be used for this purpose and shall be placed on and only on sheets of plans where the work to be performed is dependant on his determining the controlling field dimensions.”

**NOTE:
THE CONTRACTOR SHALL VERIFY ALL
CONTROLLING FIELD DIMENSIONS
BEFORE ORDERING OR FABRICATING
ANY MATERIAL.**

Suggested placement of the above cell is at the lower right hand corner or bottom edge near the title block of the subject plan sheet. The plus/minus symbol is available on your keyboard as an alternate keystroke in Microstation. See BDD Figure 18-3.1, 3.2 and others for the use of plus/minus dimensions.

18.2.0 DECK CONTOURS. See Section 4 of Bridge Design Details

Deck Contours are not required on retrofit projects. Confirm with your designer.

18.3.0 FOUNDATION PLAN See “FOUNDATION PLAN” Section 5 of Bridge Design Details.

Structures Preliminary Investigations Branch (PI) will usually provide the base Foundation Plan sheet. Seismic Retrofits do pose some logistical problems. Standard procedure would have a request for a Foundation Plan base map made early in the project schedule so any Bridge surveys that need to be done are finished in a timely manor. For a retrofit project, it is possible that the need for a Foundation Plan would not become apparent until the designer has completed some of the analysis. It's unlikely that adequate time would be available to provide a 'project specific' foundation plan. There are ways to get around this. PI usually keeps copies of previously used plans on file. It will probably be a base map that covers a very large area, but you could extract what you need and build your own foundation plan. You may also be able to find an existing contract plan set of your structure that has a .dgn plan sheet you could copy and modify to suit the current project. Whichever way you proceed; verify the accuracy of the layout. The designer should visit the site during the design process. If so, see if photographs have been taken. Photographs are a good way to verify the current site conditions. Should the inclusion of a true ‘FOUNDATION PLAN’ become impractical, a ‘LIMITS OF EXCAVATION AND BACK FILL FOR PAYMENT’ detail (or details) specific to the footing being detailed may be adequate for showing the grade/elevation data and allowing the calculation of ‘QUANTITIES’. See BDD Figure 18-8.2

Accuracy standards for locating an existing footing for retrofit may not need to be as stringent because you’re modifying a footing that already exists. However, be as accurate as possible when locating existing physical features such as roadways and curbs, buildings, above and below ground utilities and fence lines that may interfere with your design. Discuss this with your designer early. See BDD Figure 18-4.2

Once you have a satisfactory "FOUNDATION PLAN", locate retrofitted foundations as indicated but do not dimension size, as this will be shown elsewhere. On projects with super-structure work **only**, a “FOUNDATION PLAN” may not be required. Confirm with your designer.

18.4.0 ABUTMENTS See “ABUTMENTS/WINGWALLS” Section 6 of Bridge Design Details.

The types of retrofits used on cast in place reinforced concrete bridges with diaphragm type abutments are:

- Shear Keys
- Abutment Tie-downs

The types of retrofits used on cast-in-place reinforced concrete bridges with seat type abutments are:

- Seat Extenders
- Shear Keys
- Abutment tie-downs

Structures with above mentioned abutments and either pre-cast or cast-in-place ‘I’-girders could have:

- Diaphragm Modifications

The types of retrofits used on structures with steel superstructure and concrete abutments are:

- Shear Keys
- Seat Extenders
- Bearing Conversions with Pedestals
- Abutment Tie-downs

Note the example “ABUTMENT SEAT EXTENDER RETROFIT” BDA 14-5.5 shown here as BDD Figure 18-1.4.

In addition to regular abutment plans and sections, CONCRETE REMOVAL DETAILS may be required. On the existing structure these show limits of removal of unwanted substructure concrete, above and below grade. These details require dimensions for quantity take-off. There may be existing reinforcement exposed. This reinforcement should be labeled: “*Existing exposed reinforcement to remain undamaged.*” There may also be details showing the connection of the existing structure to the new retrofit components. These are DOWEL PLACEMENT DETAILS. These include views with callouts to indicate the number of dowels required and dowel pattern spacing to be used. These details should be dimensioned appropriately for quantity take-off.

For examples showing some of the above-mentioned retrofit techniques, see BDD Figures 18-5.1 thru 18-5.6.

18.4.1 APPROACH SLABS

Some Seismic Retrofits will require an EQ (10) retrofit approach slab on an existing abutment. In some cases, a paving notch must be added or the existing modified. In the XS sheets, or standard drawings, there are specialized retrofit details showing this modification. Unless the Engineer has a different design, reference the approach slab. Draw the paving notch extension as part of your abutment details and dimension the linear limits on the ABUTMENT LAYOUT for QUANTITIES, but do not specify dimensions or reinforcement. See XS sheets “SECTION 3-BRIDGE STRUCTURE APPROACHES” for ‘STRUCTURE APPROACH TYPE EQ (10)’ XS3-150e

18.5.0 BENTS See “BENTS” Section 7 of Bridge Design Details.

Bent caps usually involve cable or rod type restrainers, used on cast-in-place concrete, pre-cast concrete girders or steel girders with an independently poured concrete diaphragm. Views necessary to show coring will be required. There may be portions of concrete added to form bolsters or blocks. There may also be details showing how the existing structure and the new retrofit components are connected. These are DOWEL PLACEMENT DETAILS. Views with callouts adequate to indicate the number of dowels required and pattern spacing will be shown. These details should be dimensioned appropriately for quantity take-off. For examples, see BDD Figures 18-6.1 thru 18-6.3.

For a structure with steel girders, there will be steel brackets attached to the bottom flange of the girder as a connection point for restrainer cables or rods. Complete details for fabrication of these brackets will be required with suitable welding symbols and dimensions for quantity take off. See BDD Figures 18-11.2 thru 18-11.13, also “GUIDELINES FOR SEISMIC RETROFITS AND STRENGTHENINGS” page 15.

A means of accessing the interior of a box girder structure must be provided when using these types of restrainers. Soffit openings are the preferred type. In some cases, a deck opening may be a better choice. There are typical details available for these situations, see BDD Figures 18-2.2 (xs1-310). Note that due to the close proximity of a hinge to a related bent, some restrainer types may involve both, requiring suitable details. **See BDD**

18.5.3 HINGE DETAILS

18.5.1 COLUMNS

Retrofits applied to single columns only are usually a steel casing or a Composite (Fiberglass/Epoxy) wrap. See “STANDARD PLANS” xs7-010e and rxs7-810E for these.

Retrofits applied to multiple columns may use various types of retrofit techniques. BDD Figure 18-1.2 (BDA 14-5.4) shows an in-fill wall detail. There may also be details showing how the existing structure and the new retrofit components are connected. These are DOWEL PLACEMENT DETAILS. See **BDD 18.5.0 BENTS** above. For examples showing other configurations, see BDD Figures 18-7.4, 7.5 and 7.6.

18.5.2 FOOTINGS

Footings usually involve the addition of concrete to the perimeter and the addition of piles. These modifications could require plans and elevations of sufficient scale to indicate complex rebar placement. Show the footing “PLAN” and “PILE LAYOUT” with suitable dimensions for QUANTITIES. There may be coring of existing concrete for tie-downs and rod anchors.

CONCRETE REMOVAL DETAILS may be required. On the existing footing these show limits of removal of unwanted substructure concrete. These details require dimensions for quantity take-off. There may be existing reinforcement exposed. This reinforcement should be labeled: “*Existing exposed reinforcement to remain undamaged.*” There may also be details showing how the existing structure and the new retrofit components are connected. These are DOWEL PLACEMENT DETAILS. These include views with callouts to indicate the number of dowels required and dowel pattern spacing to be used. These details should be dimensioned appropriately for quantity take-off. For example, see BDD Figures 18-8.1 to 18-8.4.

When your project has a footing retrofit or any work requiring substructure modifications, add the sheet “LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL” xs7-310e. See BDD Figure 18-2.3.

The configuration of the restrainer tie-downs, anchor rods and associated parts may be of specific design. As such, complete details of all hardware must be detailed for QUANTITIES and for fabrication. Again, adequate dimensions are essential. See BDD Figures 18-8.5 thru 8.10. Welding symbols come into play, as well. The SDT should develop a working understanding of the use of welding symbols as defined in the American Welding Society publication “STANDARD SYMBOLS FOR WELDING, BRAZING AND NONDESTRUCTIVE EXAMINATION” AWS A2.4: 2007. Microstation has tools for creating accurate welding symbols quickly. See BDD 18-11.2 and 11.3.

Note the new pile type added to the footings and provide the appropriate details as required.

18.5.3 HINGE DETAILS

Hinges, along with Bents, are one of the most intensive retrofit components of a bridge structure. The Hinge is one part that may have Retrofit hardware included in the original plans. Bridge Design Aids “EXAMPLE SEISMIC RETROFIT DETAILS” BDA 14-5.4 (BDD Figure 18-1.3) shows the “PIPE SEAT EXTENDER & CABLE RESTRAINER DETAIL” example. This basic guideline for retrofit work is applied to an existing structure. Note the examples shown as BDD 18-2.5 and 2.6, “CABLE RESTRAINER UNIT-TYPE 2” combination cable restrainer and pipe seat extender is a two sheet set for use new construction. In either case, the GIRDER/HINGE LAYOUT would show the locations of the restrainer units. Remember, you may not need to show the portions of the structure that have no bearing on the retrofits. Use break indicators to remove un-needed distance between the Hinge centerline and the related Bent centerline. Use a dimension line with break to show correct distance between the two. Locate/dimension all access openings and cross-reference to the correct details. See BDD Figures 18-9.1, 9.2 and 18-10.1 thru 10.6

In addition to regular Hinge plans and sections, CONCRETE REMOVAL DETAILS may be required. On the existing structure these show limits of removal of unwanted superstructure concrete. These details need to show dimensions for quantity take-off. There may be existing reinforcement exposed. This reinforcement should be labeled: “*Existing exposed reinforcement to remain undamaged.*” There may also be details showing how the existing structure and the new retrofit components are connected.. These are DOWEL PLACEMENT DETAILS. These include views with callouts to indicate the number of dowels required and dowel pattern spacing to be used. These details should be dimensioned appropriately for quantity take-off.

18.6.0 TYPICAL SECTIONS See “TYPICAL SECTION” Section 8 of “Bridge Design Details”

In retrofit detailing of structures, a true TYPICAL SECTION sheet may not be recommended. It is more likely an identified ‘SECTION/ELEVATION’ taken in a specific location, maximized to show the most detail about the retrofit would be more informative. See BDD Figure 18-6.1 and 18-7.2.

18.7.0 GIRDER LAYOUTS See “GIRDER LAYOUT” Section 9 of “Bridge Design Details”

Retrofit locations are shown on this sheet. It may be possible to omit portions of the structure not relevant to the current installation. Identify retrofit types placed on centerlines and provide location dimensions as required. Show a North Arrow for each plan

Avoid too much depth of detail on small-scale plans. Use sheet references to guide the reader to the correct details. See BDD Figure 18-9.1 and 9.2.

18.8.0 RETROFIT HARDWARE FABRICATION

LAYOUT sheets may show location and application of the finished product, but these sheets are where all the brackets, mounting plates and rod anchors, etc. are detailed for quantities and assembly. All parts must be described clearly with dimensions for fabrication. If you have multiple bracket sizes or types they must all have discrete dimensions. Avoid showing detailed fasteners unless assembly, tool clearance issues or the scale of the detail supports their use. The use of a ‘drill-point’ symbol or hole labeled for the correct size fastener may be adequate. The “RECTANGULAR” and “POLAR” ARRAY tools in Microstation are ideal for placing drilling patterns based on using a symbol from a cell library. For more information on fastener usage, see “MANUAL OF STEEL CONSTRUCTION-LRFD” Vol. II, Connections Part 8. Note the Table 8-2 on page 8-11 shows the dimensions of high strength bolts and nuts. These dimensions allow accurate fasteners to be drawn. Table 8-4 on page 8-13 and Table 8-5 on page 8-14 have the clearance dimensions listed for the most common bolt/nut diameters.

Today most steel connections are bolted or welded. If your project requires the detailing of older steel structures for retrofit, rivets may need to be detailed in an as-built configuration. Note the illustration, Figure 18A on page 14 of “BDD GUIDELINES FOR RETROFITS” from the “MANUAL OF STEEL CONSTRUCTION” (AISC) circa 1980, provides all the necessary data to reproduce accurate rivets.

Along with the use of rivets, are the steel beams they hold together. Some older steel structures have beam and column shapes that are no longer manufactured. Modern guidebooks, such as “STRUCTURAL SHAPES” from Bethlehem Steel Corp and “STRUCTURAL STEEL SHAPES” by United States Steel Corp do not have the dimensions for the older members. The publication “IRON AND STEEL BEAMS 1873 TO 1952” from the “American Institute of Steel Construction” (AISC) is a historical reference handbook, that will provide the data needed when detailing older steel shapes. The TECHNICAL REFERENCE CENTER has a copy available for checkout. For other manuals and publications cited here, inquire in your Branch or group.

The source of the information to create dimensionally correct as-builts for steel structures are shop plans. Note the example BDD Figure 18-11.1. Shop plans dimension of every piece of steel needed to fabricate the bridge component shown. The “Bridge Inspection Records Information System” (BIRIS) should have what you need. Reading shop plans could be difficult. Dimensions may be unreadable, forcing the SDT to calculate them from other related dimensions.

Note the examples shown as BDD Figures 18-11.1 thru 18-11.13. These illustrate a broad range of retrofit hardware applications.

DIMENSIONS OF STRUCTURAL RIVETS (HIGH BUTTON OR ACORN HEADS)

DRIVEN HEADS

MANUFACTURED HEADS

DIE

DRIVING CLEARANCE

Diam. of Rivet, Inches			1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	
Driven Head Inches	Full	A	1.5 D + 1/8	7/8	1 1/16	1 1/4	1 7/16	1 5/8	1 13/16	2	2 3/16	
		H	.425 A	3/8	7/16	17/32	5/8	1 1/16	3/4	27/32	1	
Driven Head Inches	Ctsk.	F	1.5 H	9/16	11/16	13/16	15/16	1 1/32	1 5/32	1 9/32	1 13/32	
		C	1.81 D	29/32	1 1/8	1 11/32	1 19/32	1 13/16	2 1/32	2 1/4	2 1/2	
Manufactured Head Inches	Full	K	.5 D	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	
		A	1.5 D + 1/32	25/32	31/32	15/32	1 11/32	1 17/32	1 23/32	1 29/32	2 3/32	
Manufactured Head Inches	Full	H	.75 D + 1/8	1/2	19/32	11/16	25/32	7/8	31/32	1 1/16	1 5/32	
		F	.75 D + 9/32	21/32	3/4	27/32	15/16	1 1/32	1 1/8	1 7/32	1 5/16	
Manufactured Head Inches	Full	M	.50	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	
		N	.094	3/32	3/32	3/32	3/32	3/32	3/32	3/32	3/32	
Manufactured Head Inches	Full	G	.75 D - 9/32	3/32	3/16	9/32	3/8	15/32	9/16	21/32	3/4	
		C	1.81 D	29/32	1 1/8	1 11/32	1 19/32	1 13/16	2 1/32	2 1/4	2 1/2	
Manufactured Head Inches	Ctsk.	K	.5 D	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	
		B		1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	
Die, In.												
Driving Clearance Inches			E (min.)	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	
			E (pref.)	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	

AMERICAN INSTITUTE OF STEEL CONSTRUCTION

Figure 18A

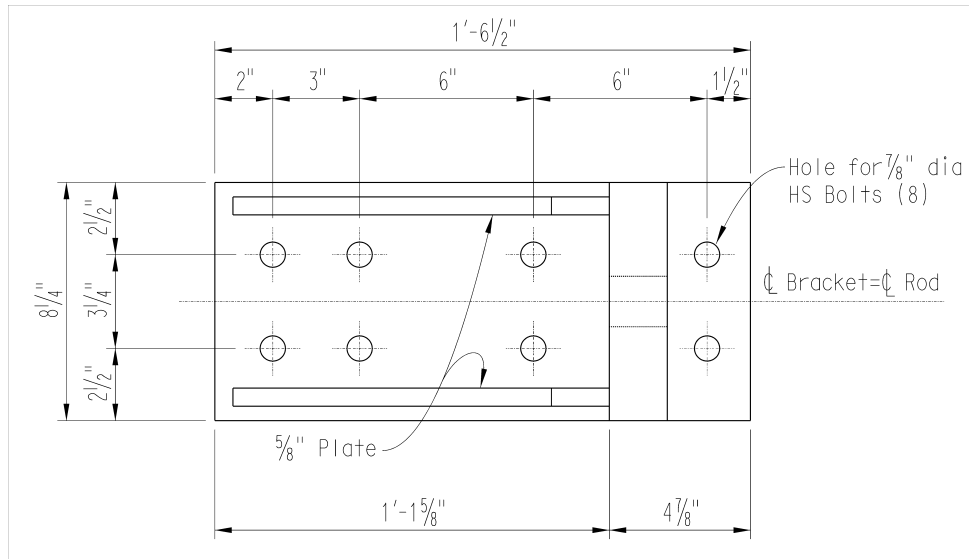


Figure 18B

A typical Plan View of a Rod Bracket.

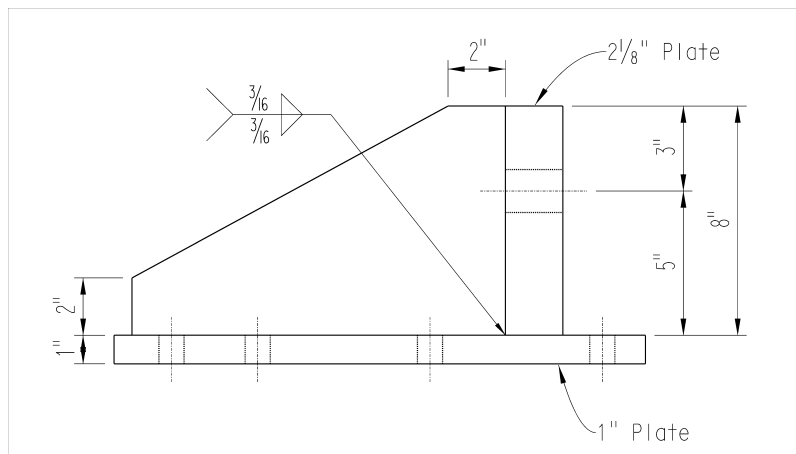


Figure 18C

A typical Elevation View of a Rod Bracket.

The above bracket could be applied to strengthenings and retrofits. They could have multiple rod configurations and have different rod diameters. Cable restrainer systems use the same basic bracket as well.



LIST OF EXAMPLES – SECTION 18

Basic Retrofit Examples From “BRIDGE DESIGN AIDS” (14-5.2 thru 14-5.5):
Examples Figures 18-1.1, 1.2, 1.3 and 1.4

XS Sheets “INDEX TO XS SHEETS”

“SECTION 1-BRIDGE SUPERSTRUCTURE xs1-310 DECK AND SOFFIT OPENINGS”

“SECTION 7 – BRIDGE SIESMIC” (Complete):

Examples Figures 18-2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, and 2.9

General Plans:

Example Figures 18-3.1 and 3.2

Foundation Plans:

Examples Figures 18-4.1 and 4.2

Abutment Details:

Examples Figures 18-5.1, 5.2, 5.3, 5.4, 5.5 and 5.6

Bent/Pier Cap Details:

Examples Figures 18-6.1, 6.2 and 6.3

Column Details:

Examples Figures 18-7.1, 7.2, 7.3, 7.4, 7.5 and 7.6

Footing Details:

Examples Figures 18-8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9 and 8.10

Girder Layouts:

Examples Figures 18-9.1 and 8-9.2

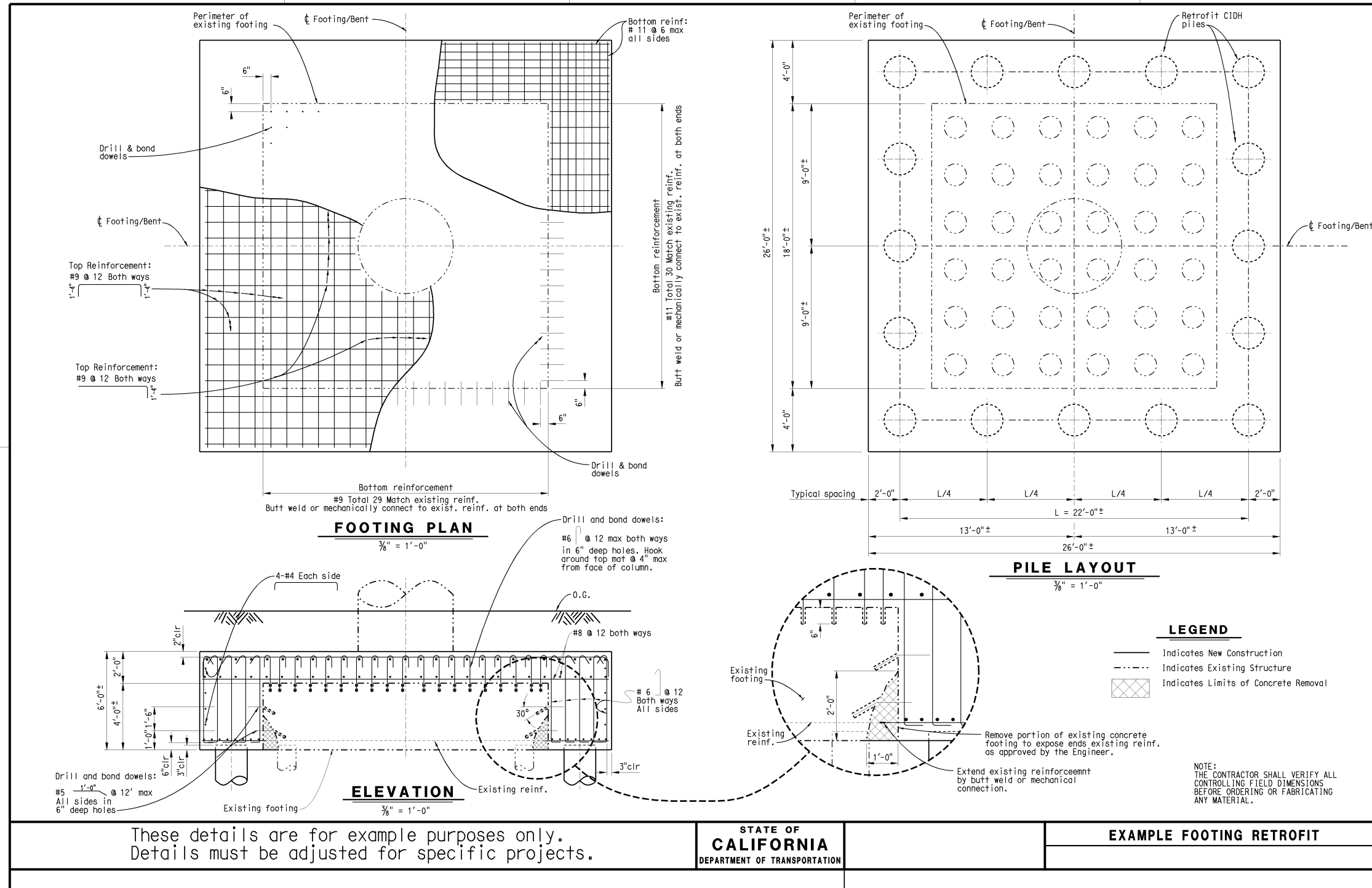
Hinge Details:

Examples Figures 18-10.1, 10.2, 10.3, 10.4, 10.5 and 10.6

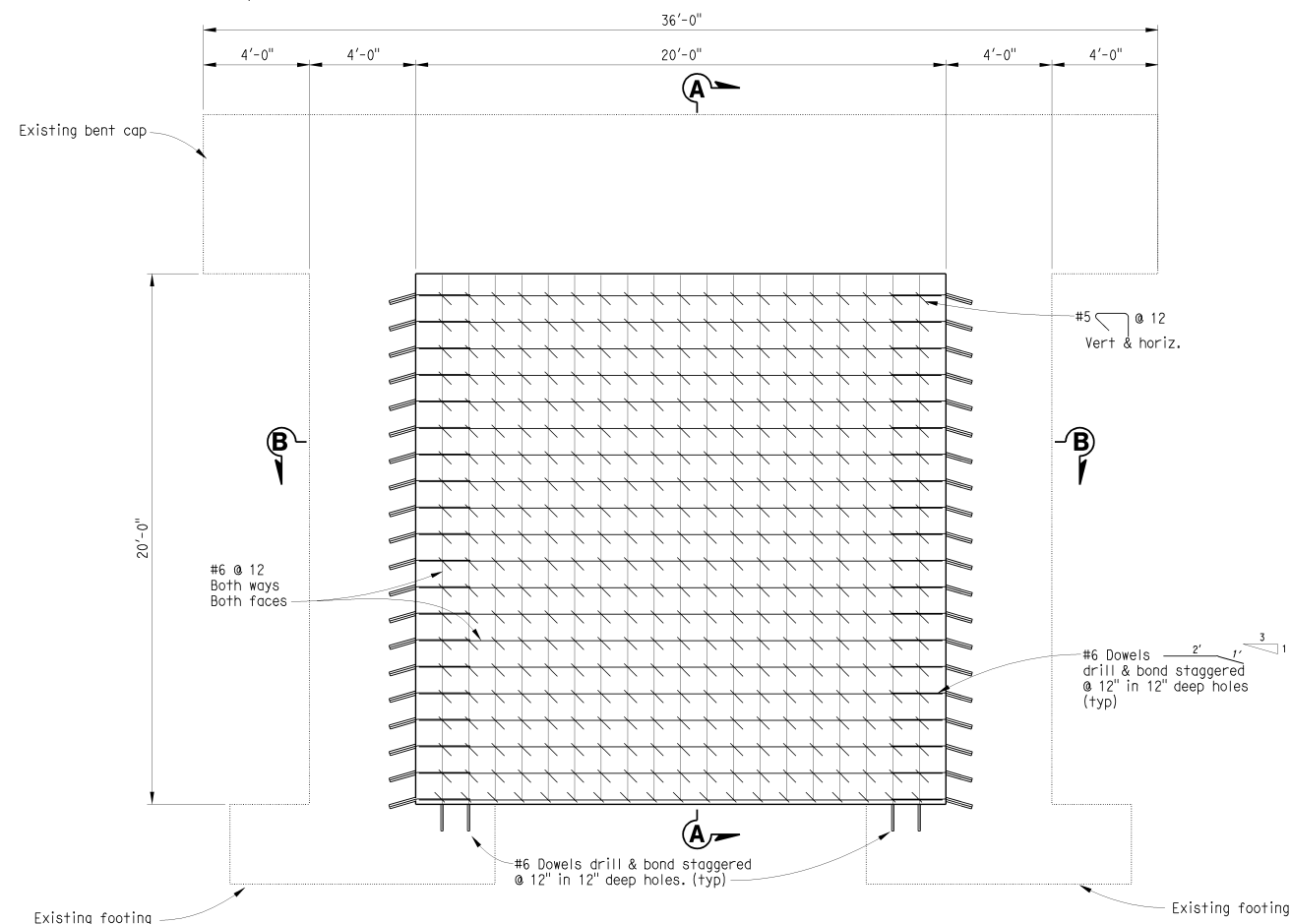
Steel Details:

Examples Figures 18-11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, 11.8, 11.9, 11.10, 11.11, 11.12
And 11.13

The following 4 sheets are extracted from BRIDGE DESIGN AIDS Section 14-5. They support MEMOS TO DESIGNERS Section 20-4 with basic guideline details

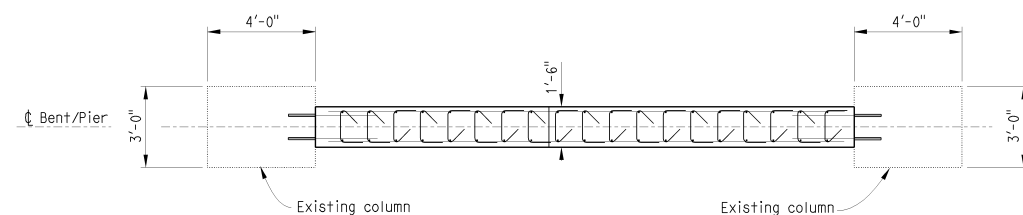


BDA 14-5.2



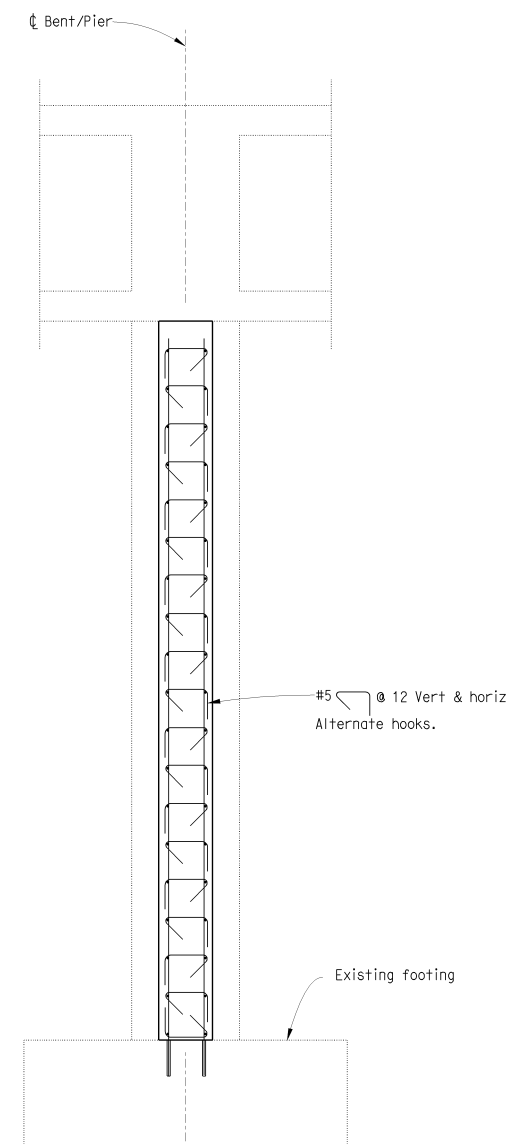
ELEVATION

$\frac{3}{8}" = 1'-0"$



SECTION B-B

$\frac{3}{8}" = 1'-0"$



SECTION A-A

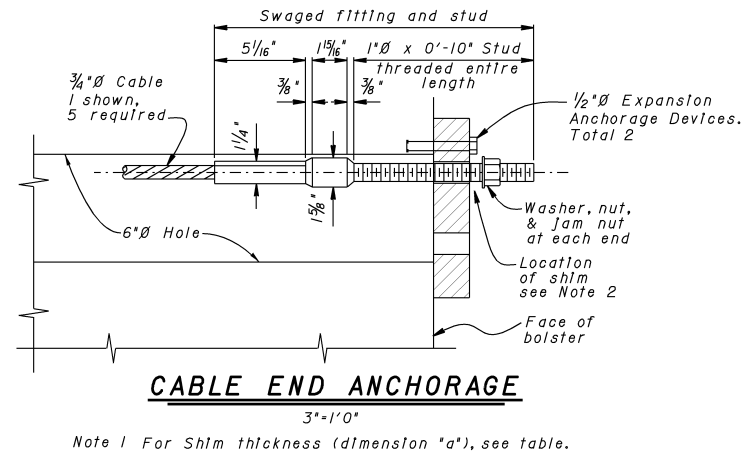
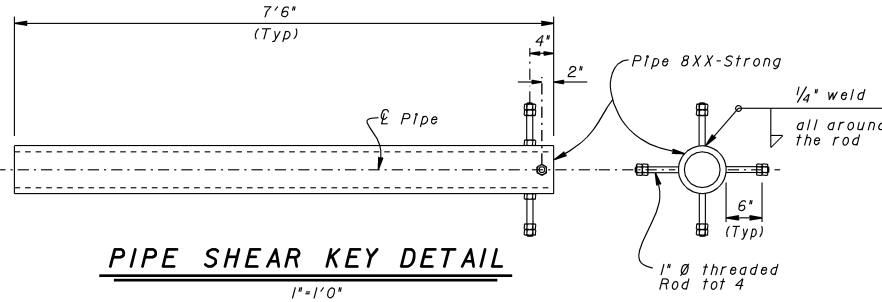
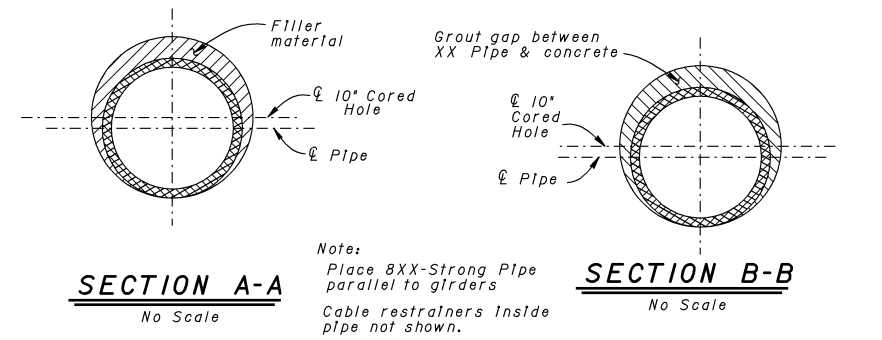
$\frac{1}{2}" = 1'-0"$

STATE OF
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

EXAMPLE BRIDGE WITH INFILL WALL RETROFIT

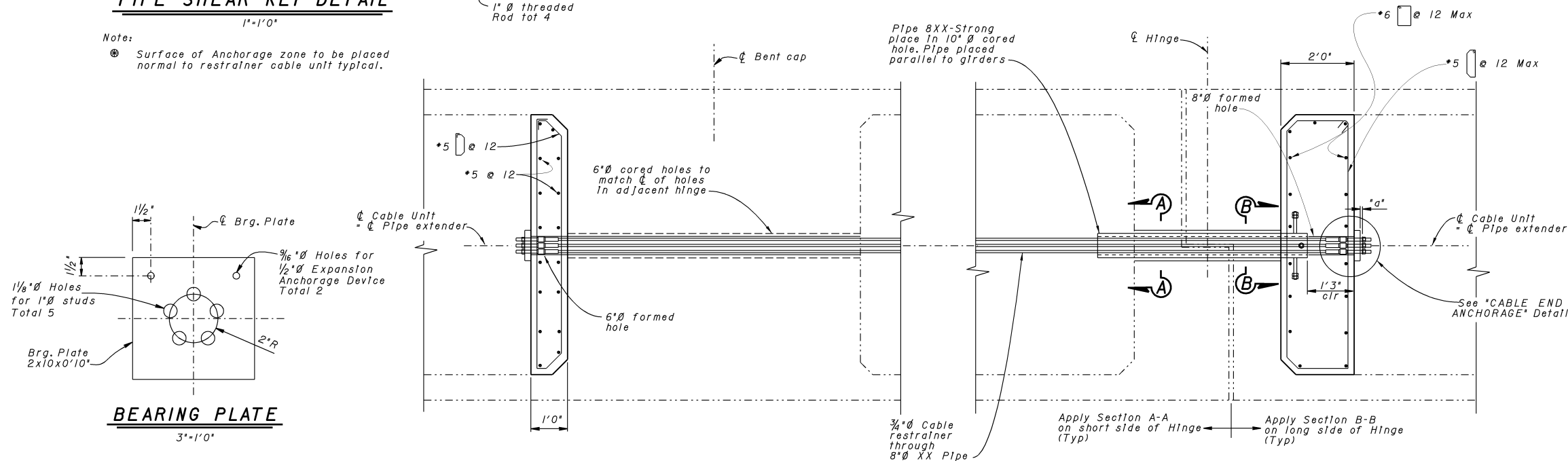
infill_wall_sht.dgn

BDA 14-5.3



- Cable Installation Notes:**
- At Bent side
Place Anchor Plate flush against Bolster face. Tighten nuts snug against Anchor Plate. Place thread locking compound
 - At Hinge side
Place Shlms between Anchor Plate and Bolster face. Tighten nuts to 100 ft-lbs torque
Place thread locking fluid
Remove shlms
Shlm thickness to be in accordance with table

Structure Temp. (°F)	Shlm Thickness (in)	
	Left Bridge	Right Bridge
30	0.5	0.5
50	1.25	1.25
70	2.0	2.0
90	2.75	2.75
110	3.5	3.5

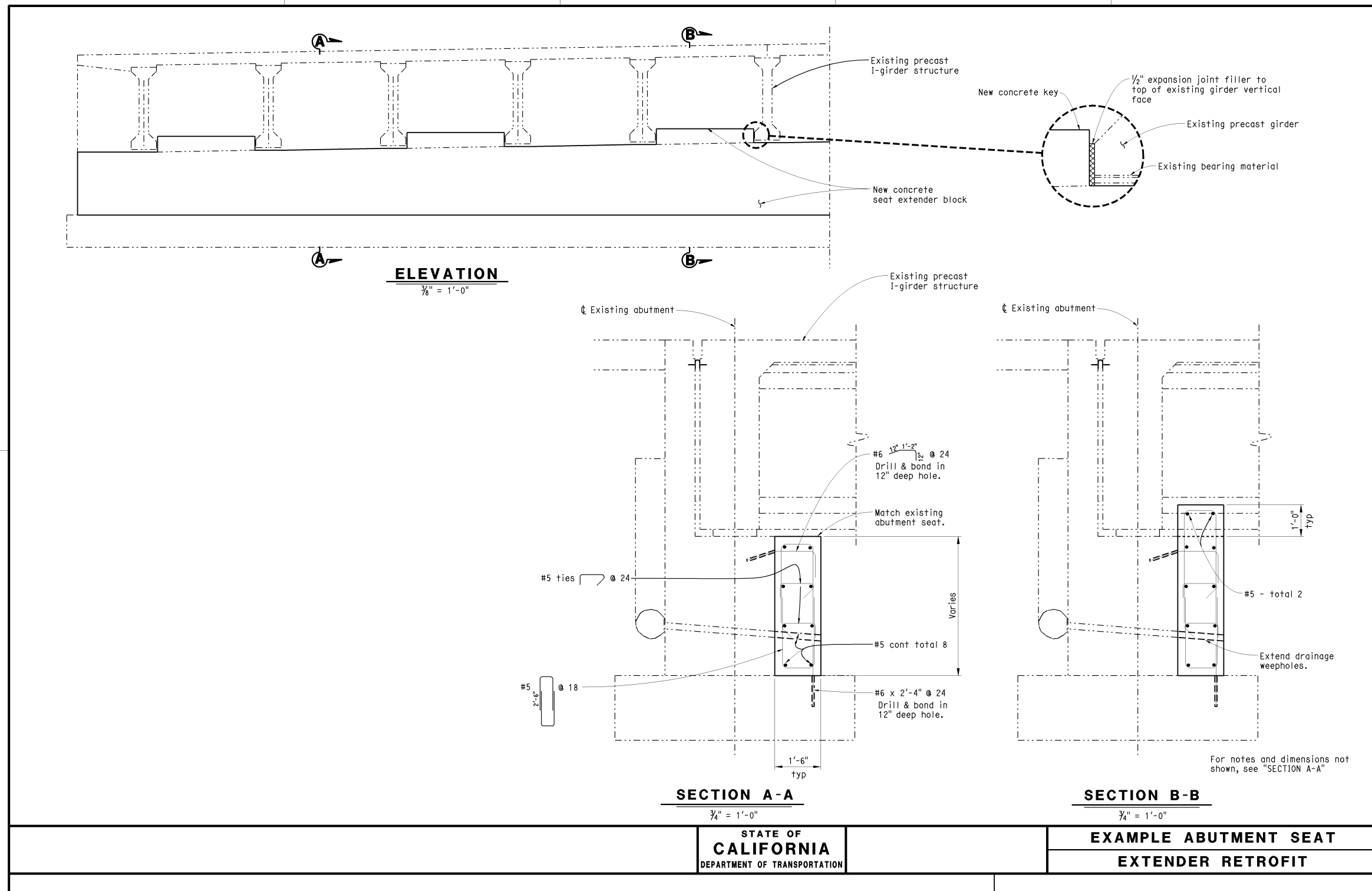


STATE OF
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

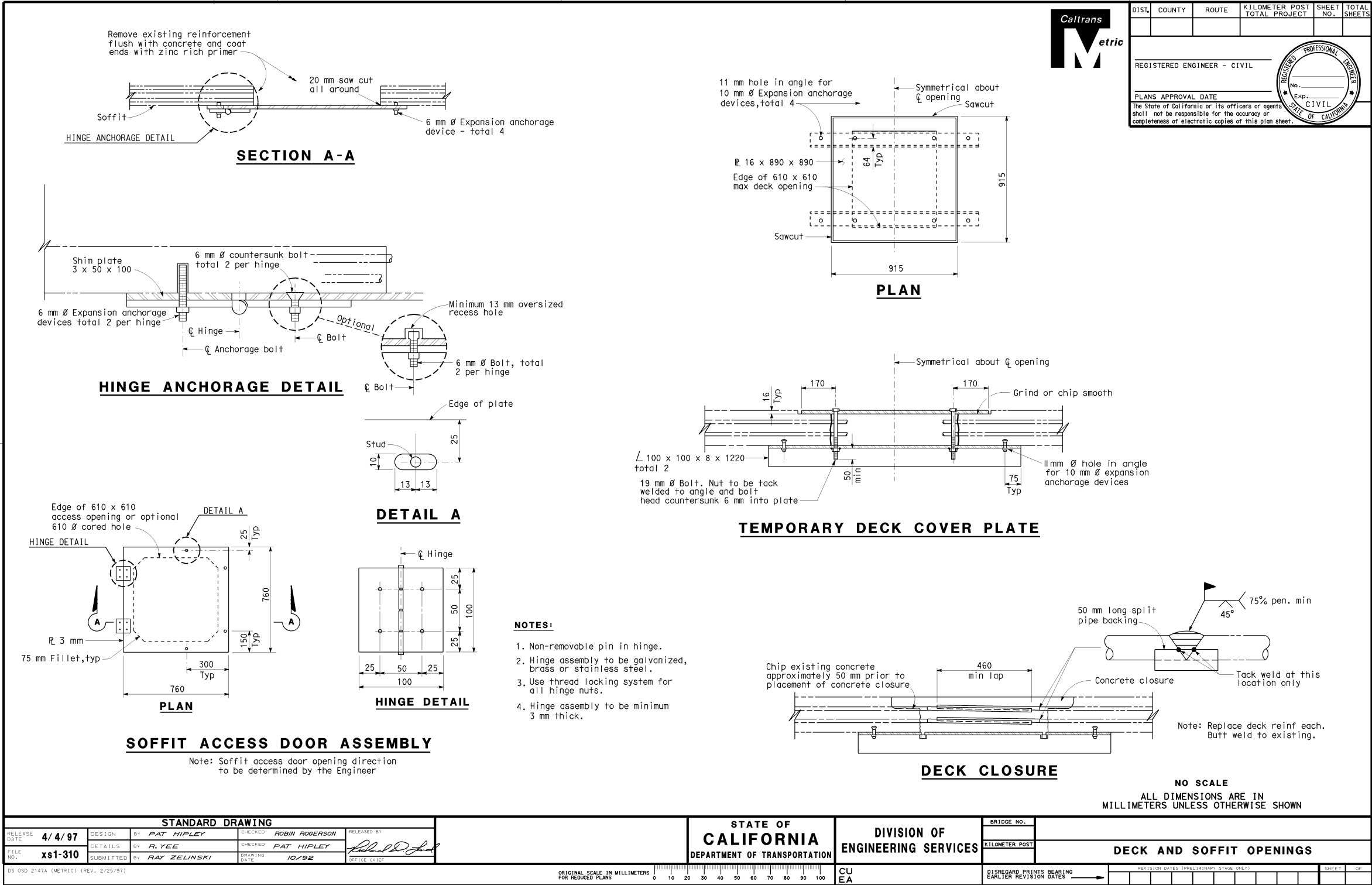
EXAMPLE PIPE SEAT EXTENDER & CABLE RESTRAINER DETAIL

hinge_rest_bda14-5-4.dgn

BDA 14-5.4

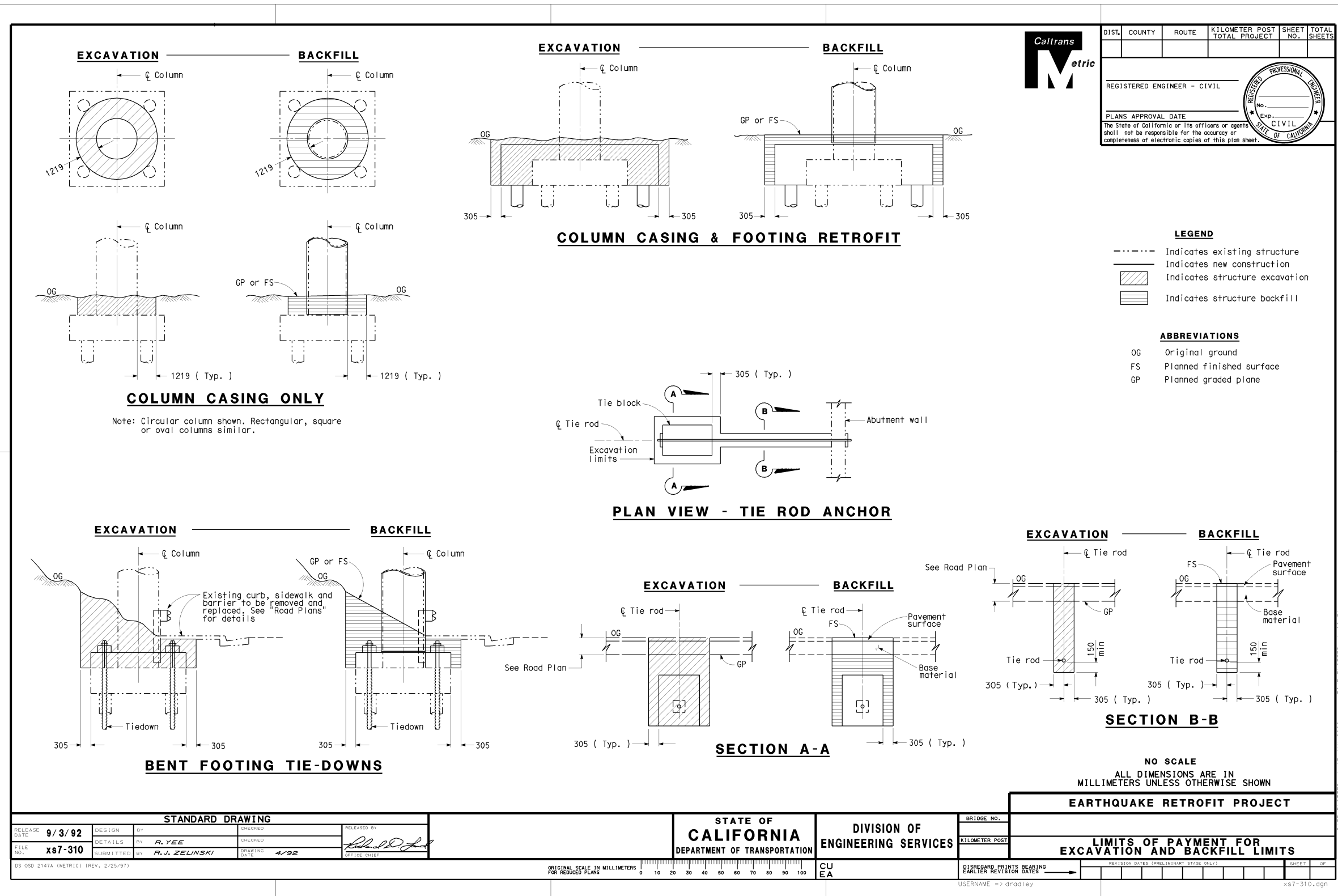


BDA 14-5.5

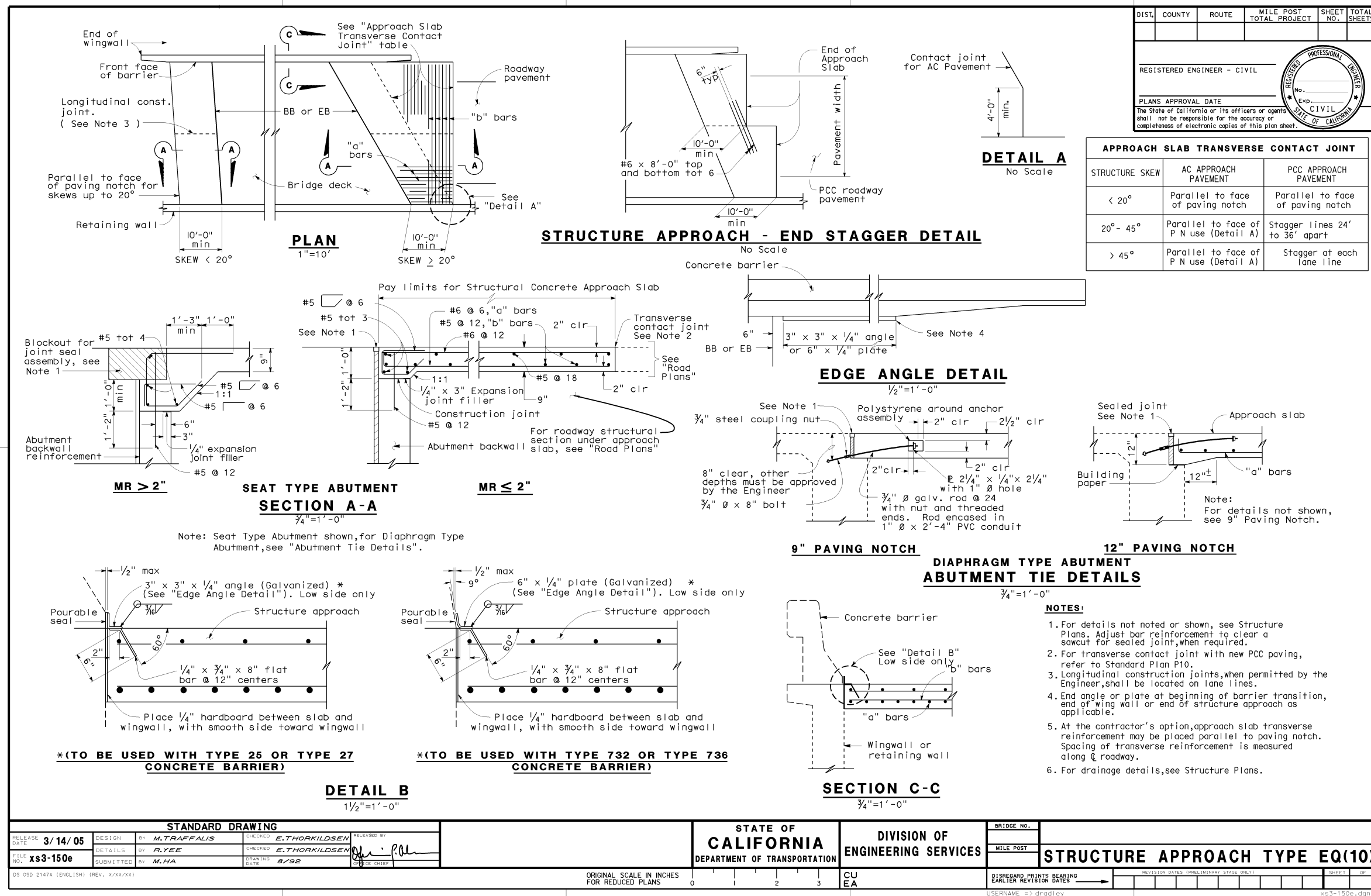


Please see “BRIDGE DESIGN DETAILS”, “SECTION 1 – GENERAL DETAILING” pages 1-16.1, 16.2, and 16.3 for proper handling of bridge standard detail sheets (xs).

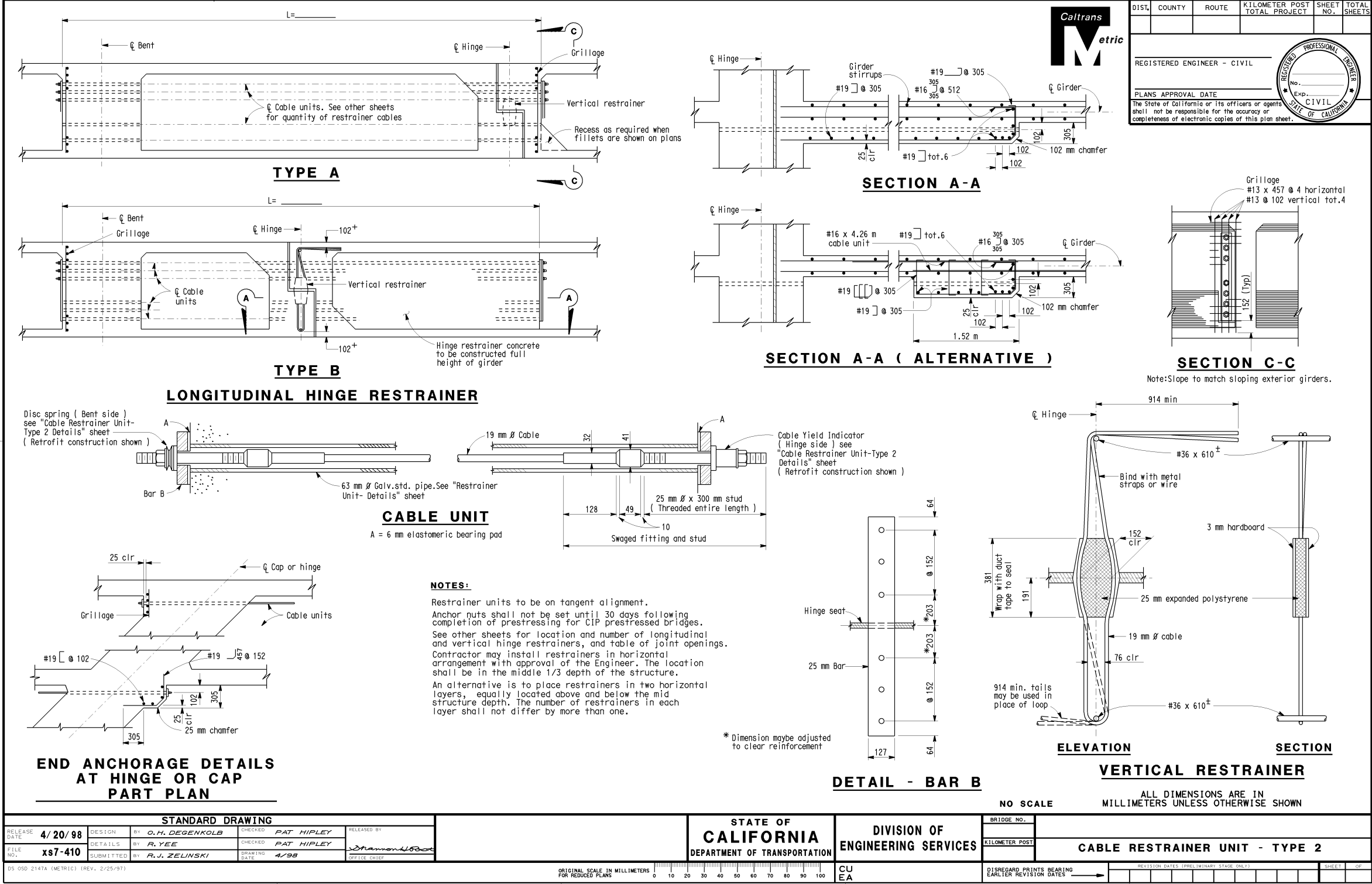
This ‘xs’ sheet provides the necessary information for adding access to interior of a concrete box girder structure. Note that this sheet, xs1-310 is listed in “SECTION 1 - BRIDGE SUPERSTRUCTURE” and not in “SECTION 7 – BRIDGE SEISMIC”.



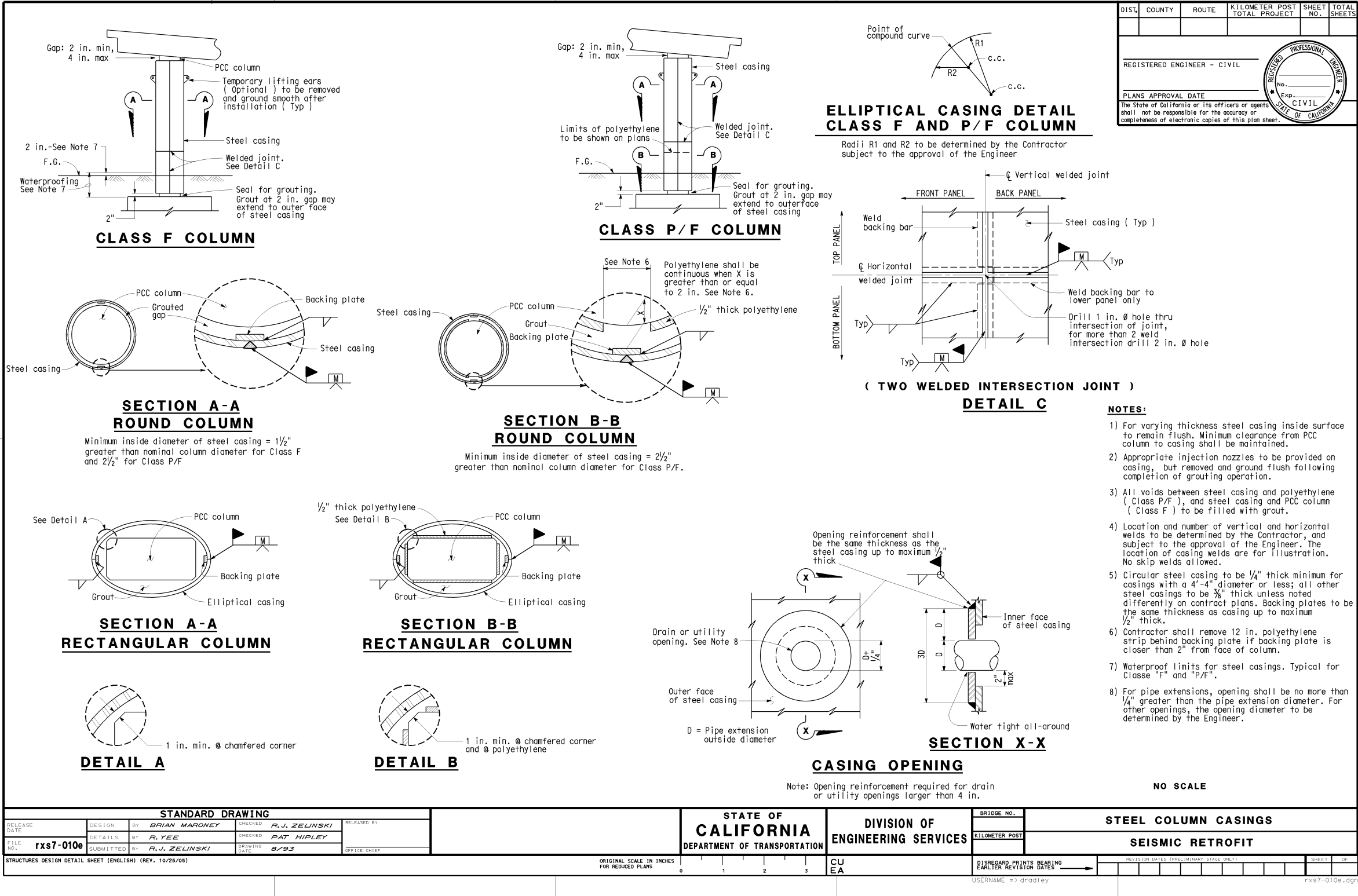
When you have modification to bent footings, this sheet must be included in the plan set. See BDD 18-3.0.



This 'xs' sheet provides the necessary information for adding an approach slab to a project structure. Note that this sheet, xs3-150e is listed in "SECTION 3 - BRIDGE STRUCTURE APPROACH" and not in "SECTION 7 – BRIDGE SEISMIC".



This sheet xs7-410 and its companion xs-7-420 provide details for the installation of cable restrainer system at time of new construction.

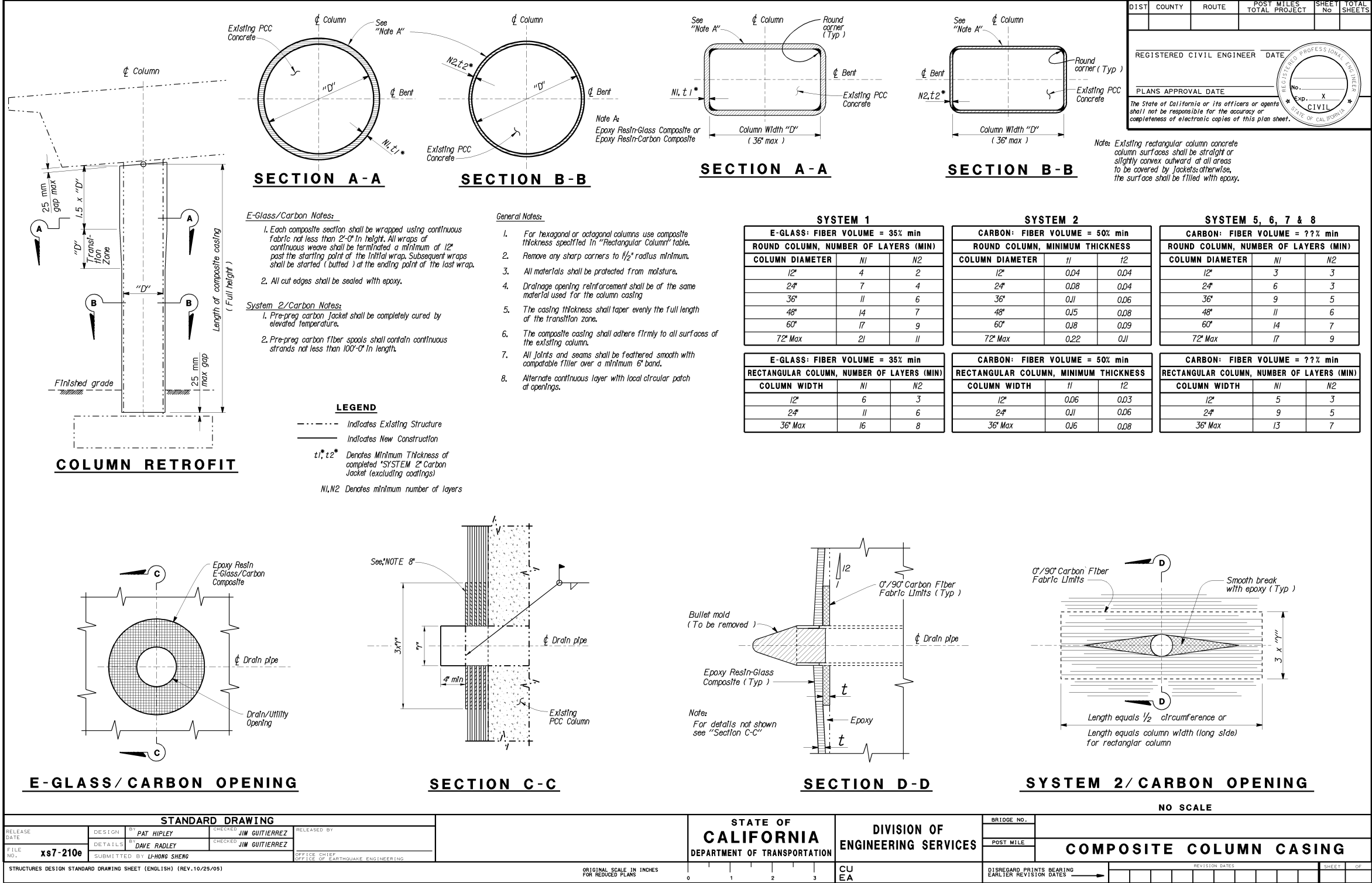


DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
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PLANS APPROVAL DATE					
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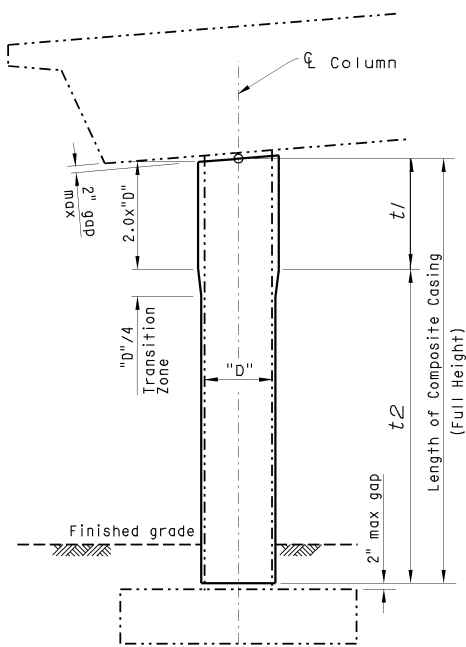


DATE PLOTTED => 05-DEC-2008 TIME PLOTTED => 11:10

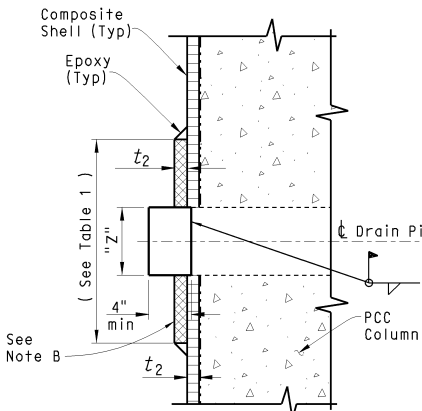
STANDARD DRAWING					BRIDGE NO.		STEEL COLUMN CASINGS	
RELEASE DATE	DESIGN BY	BRIAN MARONEY	CHECKED	R.J. ZELINSKI	RELEASED BY			
FILE NO.	DETAILS BY	R. YEE	CHECKED	PAT HIPLEY				
rxs7-010e	SUBMITTED BY	R.J. ZELINSKI	DRAWING DATE	8/93				
STRUCTURES DESIGN DETAIL SHEET (ENGLISH) (REV. 10/25/05)					KILOMETER POST		SEISMIC RETROFIT	
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS					DISCARD PRINTS BEARING EARLIER REVISION DATES		REVISION DATES (PRELIMINARY STAGE ONLY)	
0 1 2 3					CU EA		SHEET OF	
					USERNAME => dradley		rxs7-010e.dgn	



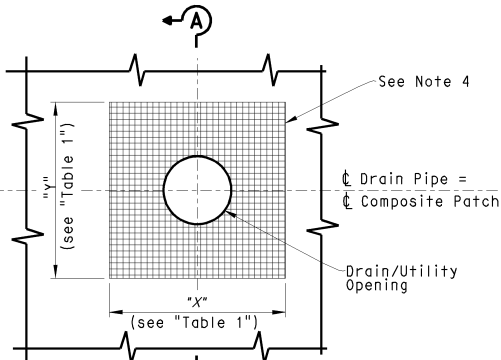
TIME PLOTTED => 12:59
 USERNAME => jgabrielploTTED => 08-DEC-2008



COLUMN RETROFIT
NO SCALE



SECTION A-A
NO SCALE



E-GLASS OPENING
NO SCALE

GENERAL NOTES

1. Prefabricated composite shells shall be fitted to the column to accommodate super elevation and drain openings.
2. Prefabricated shells shall be adhered to every surface of the column and adjacent shell with on-site mixed 2-part epoxy resin.
3. All prefabricated composite shells shall be butted vertically.
4. Drainage opening reinforcement shall be the same material used for the column casing with modified fiber orientation.
5. All cut edges shall be sealed with epoxy.
6. For column heights less than 5x'D', use constant thickness full height of t1.
7. All materials shall be protected from moisture.
8. The casing thickness shall taper evenly the full length of the transition zone using epoxy.
9. Construction of the casing shall be such that all gaps, interior and exterior of the casings are filled with epoxy.

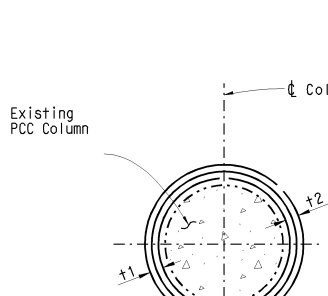
LEGEND

- Indicates Existing Structure
- Indicates New Construction
- t1, t2 Denotes Amount of Epoxy Vinylster Shells

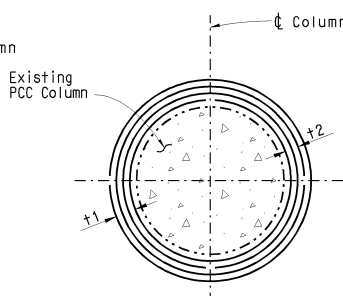
TABLE 1		
E - GLASS PATCH		
COLUMN DIA	"X" & "Y" EQUALS	"Z" EQUALS
12"		"Z"+14"
24"		"Z"+14"
36"		"Z"+20"
48"		"Z"+26"
60"		"Z"+32"
72"		"Z"+38"

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
REGISTERED CIVIL ENGINEER			DATE		
PLANS APPROVAL DATE					
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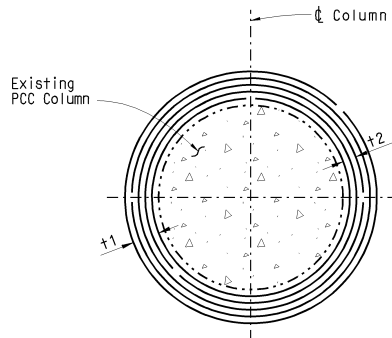
SYSTEM 4			
FIBER VOLUME = 45% min			
PREFABRICATED COMPOSITE SHELLS			
ROUND COLUMN			
COLUMN DIA	INDIVIDUAL SHELL THICKNESS	NO. OF SHELLS t1	NO. OF SHELLS t2
12"	.10"	3	3
24"	.10"	4	3
36"	.10"	5	3
48"	.10"	6	3
60"	.10"	7	4
72"	.10"	8	4



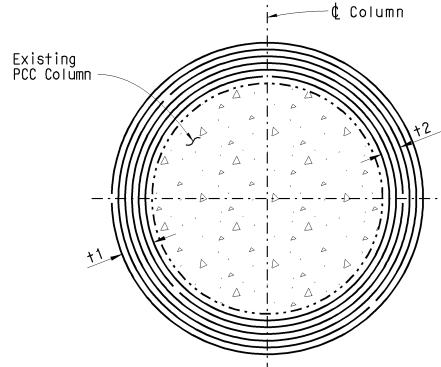
12" / 24" DIA



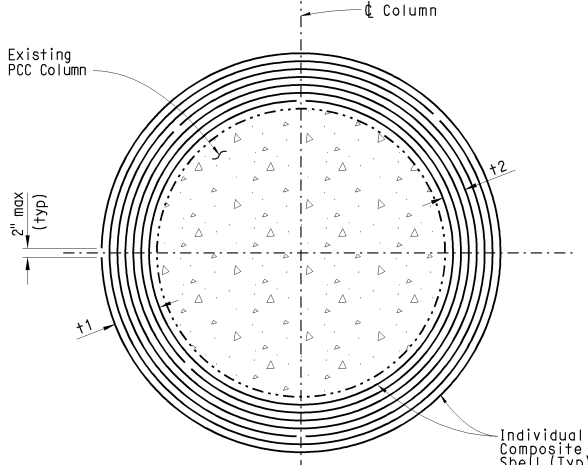
36" DIA



48" DIA



60" DIA



72" DIA

PREFABRICATED COMPOSITE SHELLS ON CONCRETE COLUMN

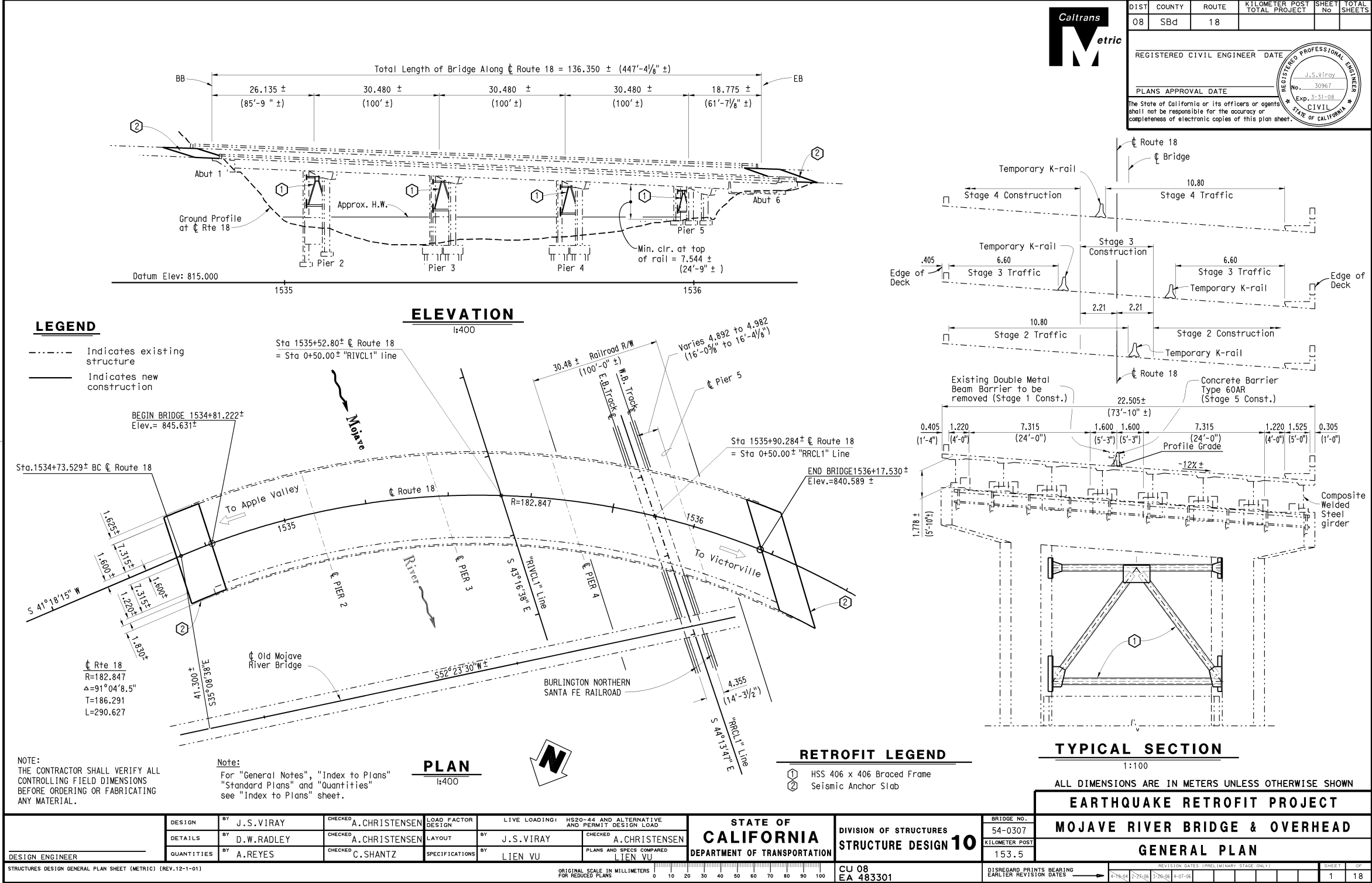
NO SCALE

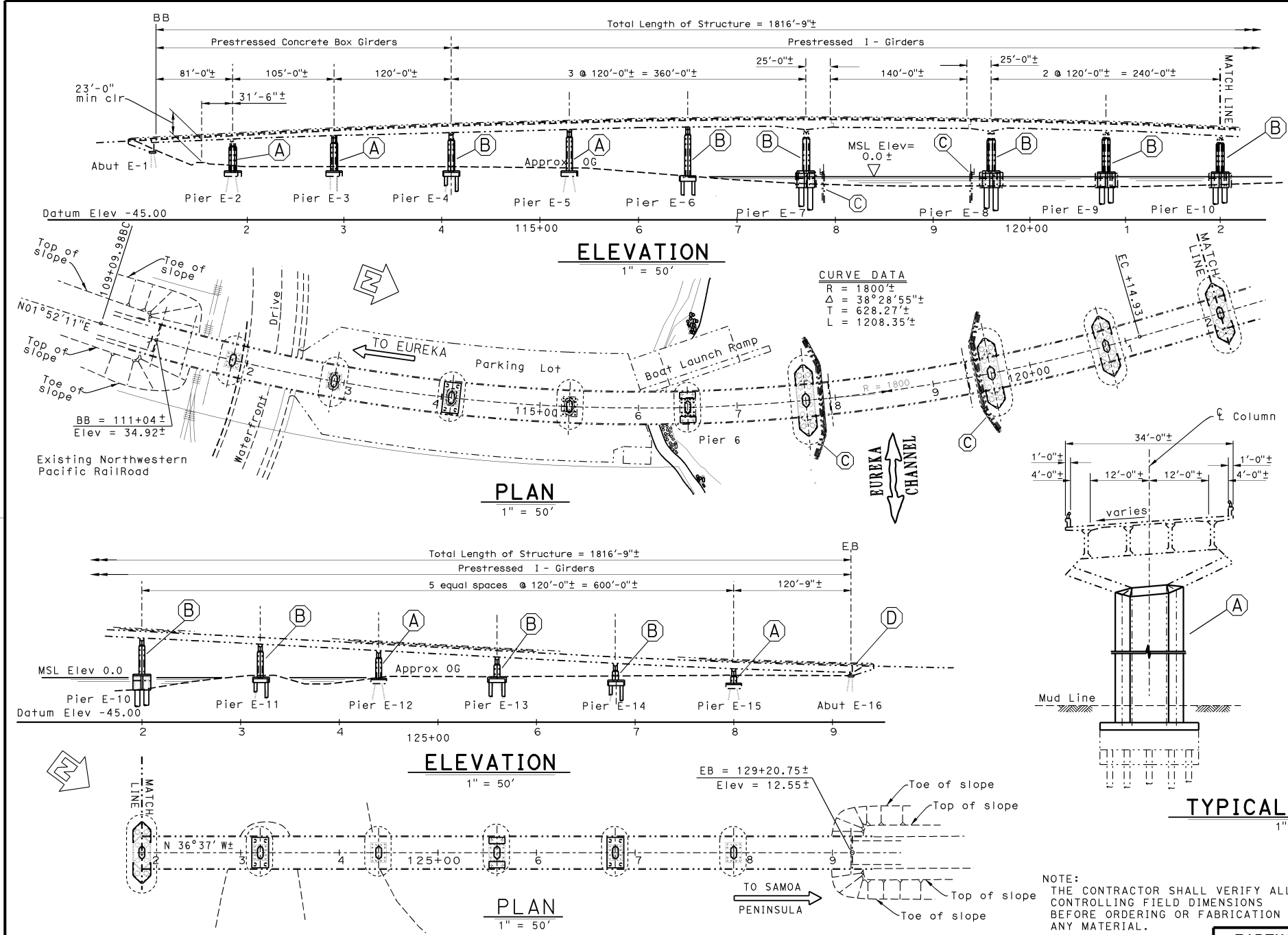
STANDARD DRAWING				STATE OF CALIFORNIA		DIVISION OF ENGINEERING SERVICES		BRIDGE NO.		POST MILE		COMPOSITE COLUMN SYSTEM 4	
RELEASE DATE	DESIGN BY PAT HIPLEY	CHECKED JIM GUTIERREZ	RELEASED BY	DEPARTMENT OF TRANSPORTATION		CU EA		DISREGARD PRINTS BEARING EARLIER REVISION DATES		REVISION DATES		SHEET OF	
FILE NO. xs7-810e	DETAILS BY DAVE RADLEY	CHECKED JIM GUTIERREZ	SUBMITTED BY LI-HONG SHENG	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS		FILE => xs7-810e.dgn							

The following two pages show examples of “GENERAL PLANS”. Through the use of Legends they clearly indicate and describe the retrofit work to be done. See “BRIDGE DESIGN DETAILS SECTION 1-GENERAL PLANS”

Note the first page shows the installation of a seismic anchor slab that encroaches on both lanes of traffic. This requires the use of “STAGE CONSTRUCTION” practices. For more information on “STAGE CONSTRUCTION” see “BRIDGE DESIGN DETAILS SECTION 17-WIDENINGS”.

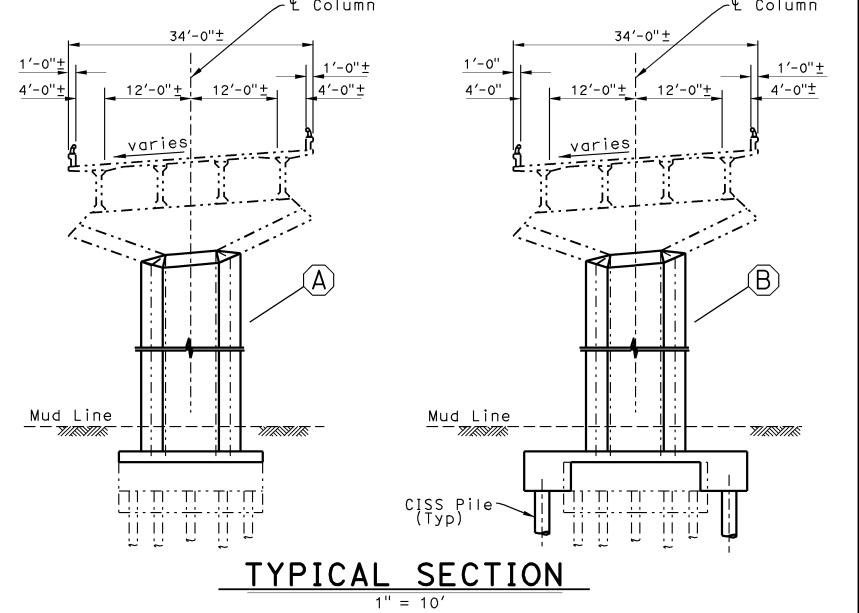
This structure over crosses railroad right-of-way. The “GENERAL PLAN “ will be submitted the railroad operator, and as this was a metric project the details are dimensioned in U.S. Customary units as well as metric. See “BDD SECTION 12-RAILROADS”





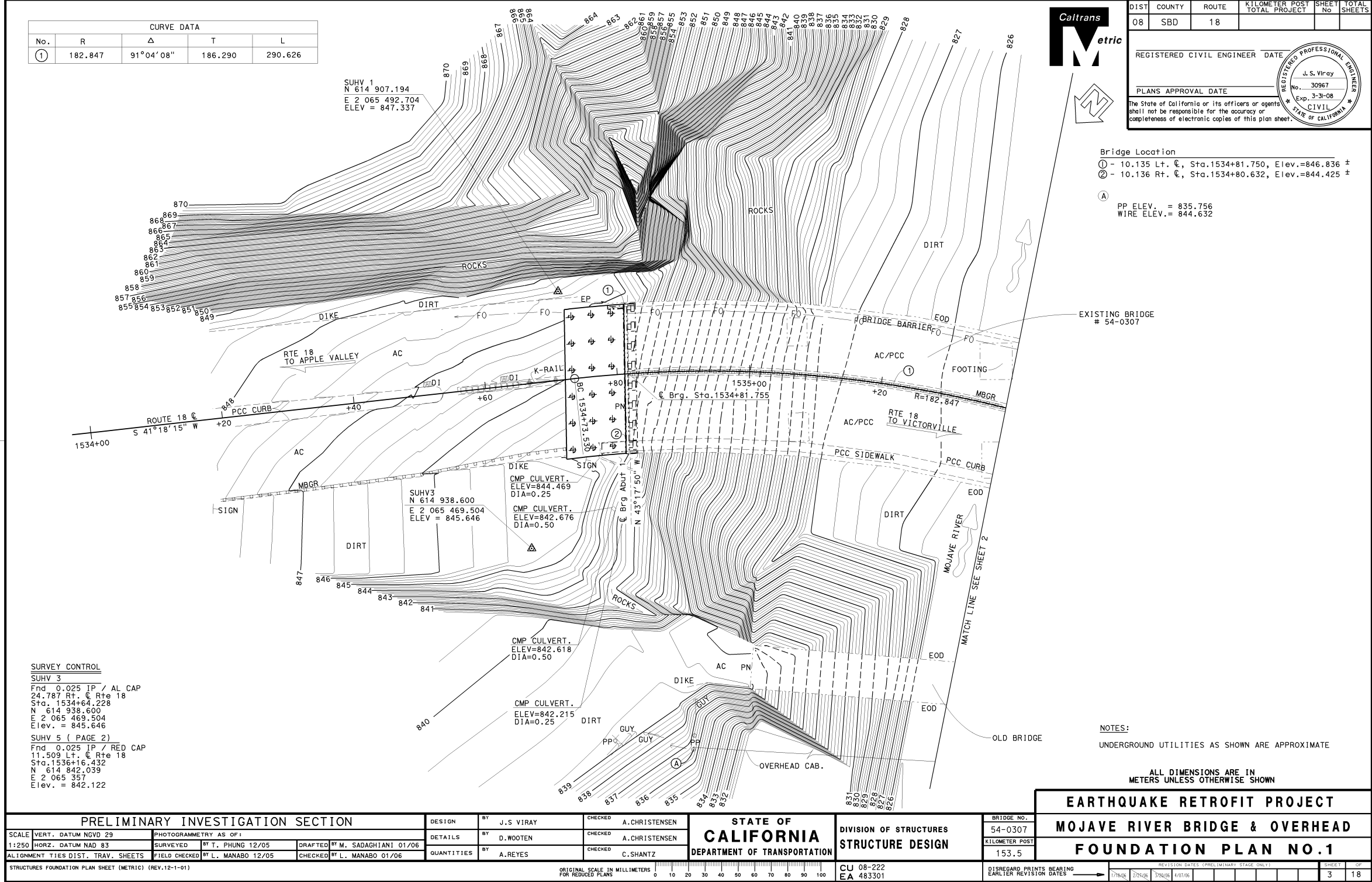
DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
01	HUM	255			

- LEGEND**
- Indicates Existing Structure
 - Indicates New Construction
 - Indicates Area of Retrofit Work
 - (A) Indicates Concrete Column Casing with Footing Overlay
 - (B) Indicates Concrete Column Casing with Footing Overlay & Piling
 - (C) Indicates Removal of Dolphin Piles & Fender
 - (D) Indicates addition of Abutment Keys



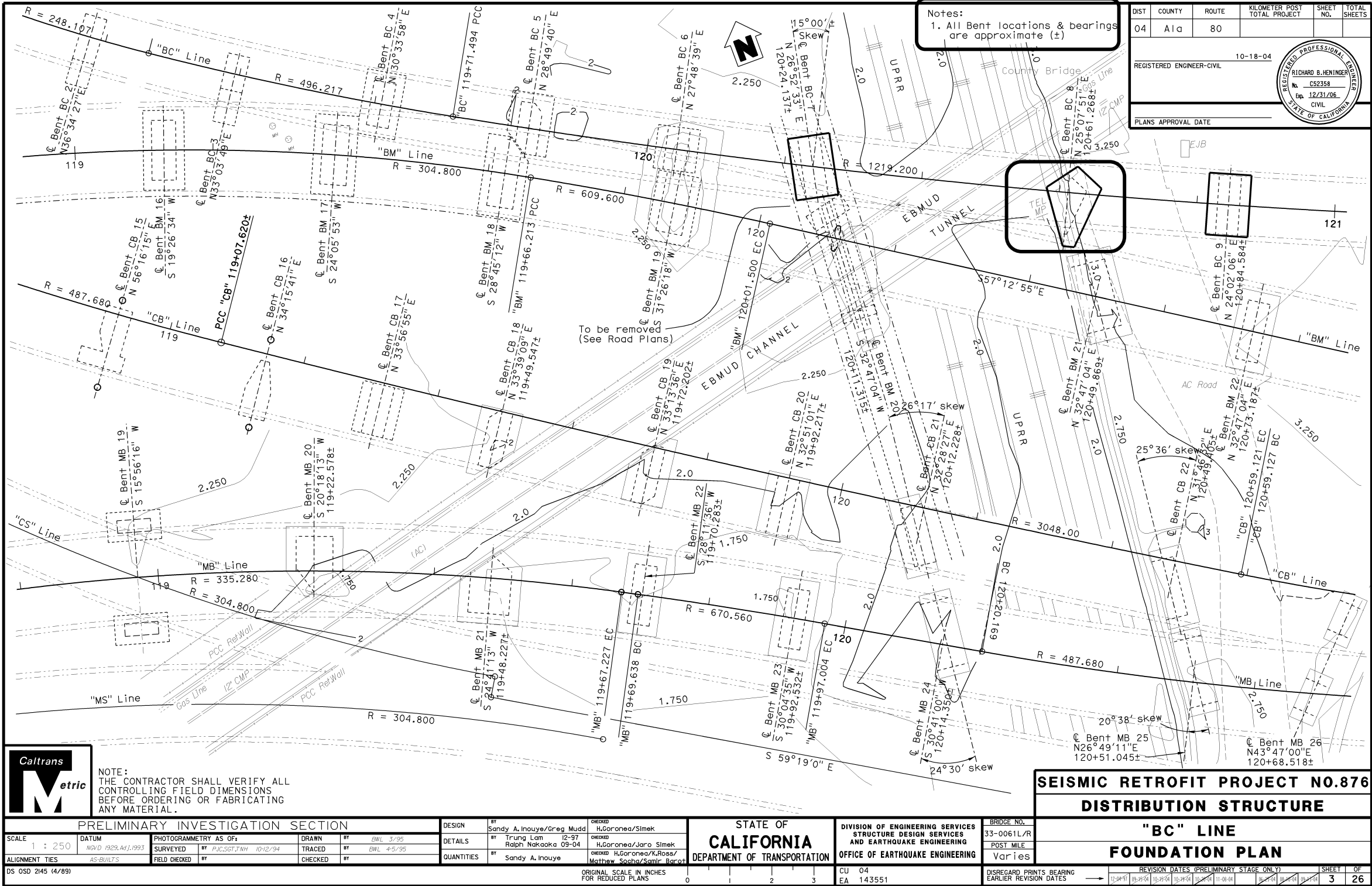
NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATION ANY MATERIAL.

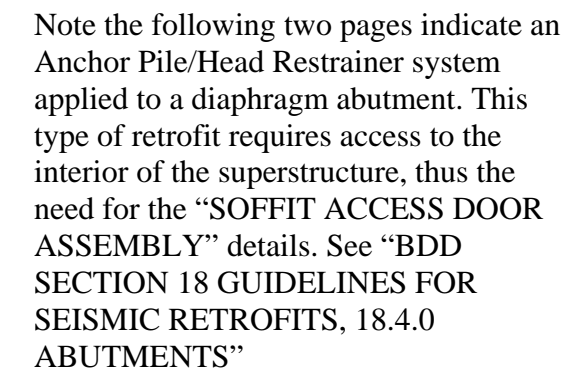
DESIGN ENGINEER				DESIGN				LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD				STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION				ENGINEERING SERVICE CENTER OFFICE OF EARTHQUAKE ENGINEERING				BRIDGE NO. 04-230 POST MILE 0.2				EARTHQUAKE RETROFIT PROJECT NO.601A EUREKA CHANNEL BRIDGE GENERAL PLAN				REVISION DATES (PRELIMINARY STAGE ONLY)				SHEET 3 OF 59			
BY Fadel Alameddine 11-98				CHECKED Garry Tolen 11-98				BY Ralph Nakaaka				FILE => 03_gpeurek.dgn				DISCARD PRINTS BEARING EARLIER REVISION DATES				DATE PLOTTED => 14:55				USERNAME => gradiev											

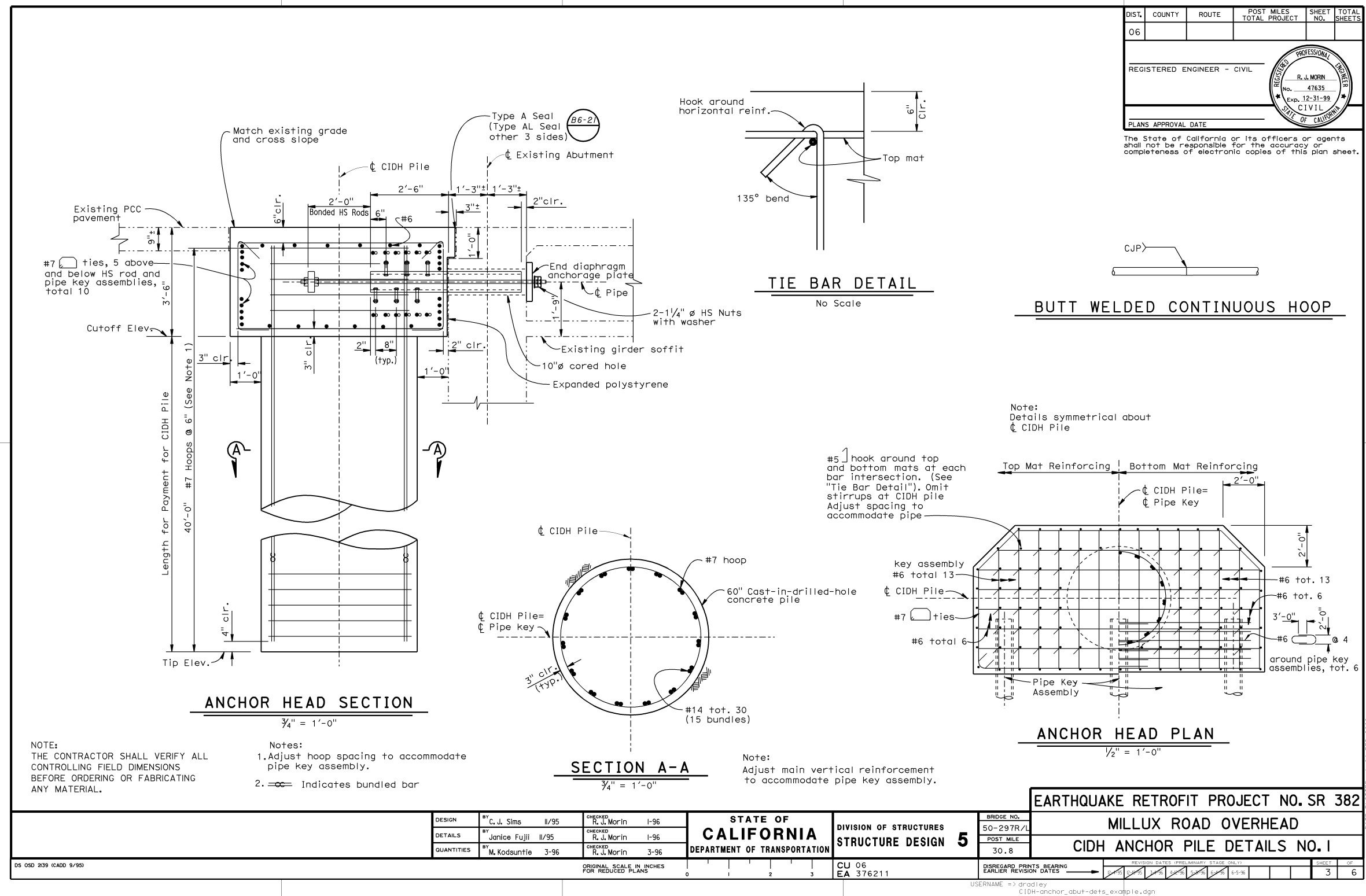


Note the odd shape of the footing referred to as “Bent BC 8”. It’s obvious that serious constraints were driving the original design of this footing. The seismic retrofit was also required to follow those same controlling factors. In this situation the actual mathematical location, bearing and station value of the footing, may not be as important as the footings relationship to fixed physical features near it. In this case a tunnel and a railroad right-of-way controlled the shape of the retrofitted footing. See “BDD SECTION 18 GUIDELINES FOR SEISMIC RETROFITS, 18.3.0 FOUNDATION PLAN.”

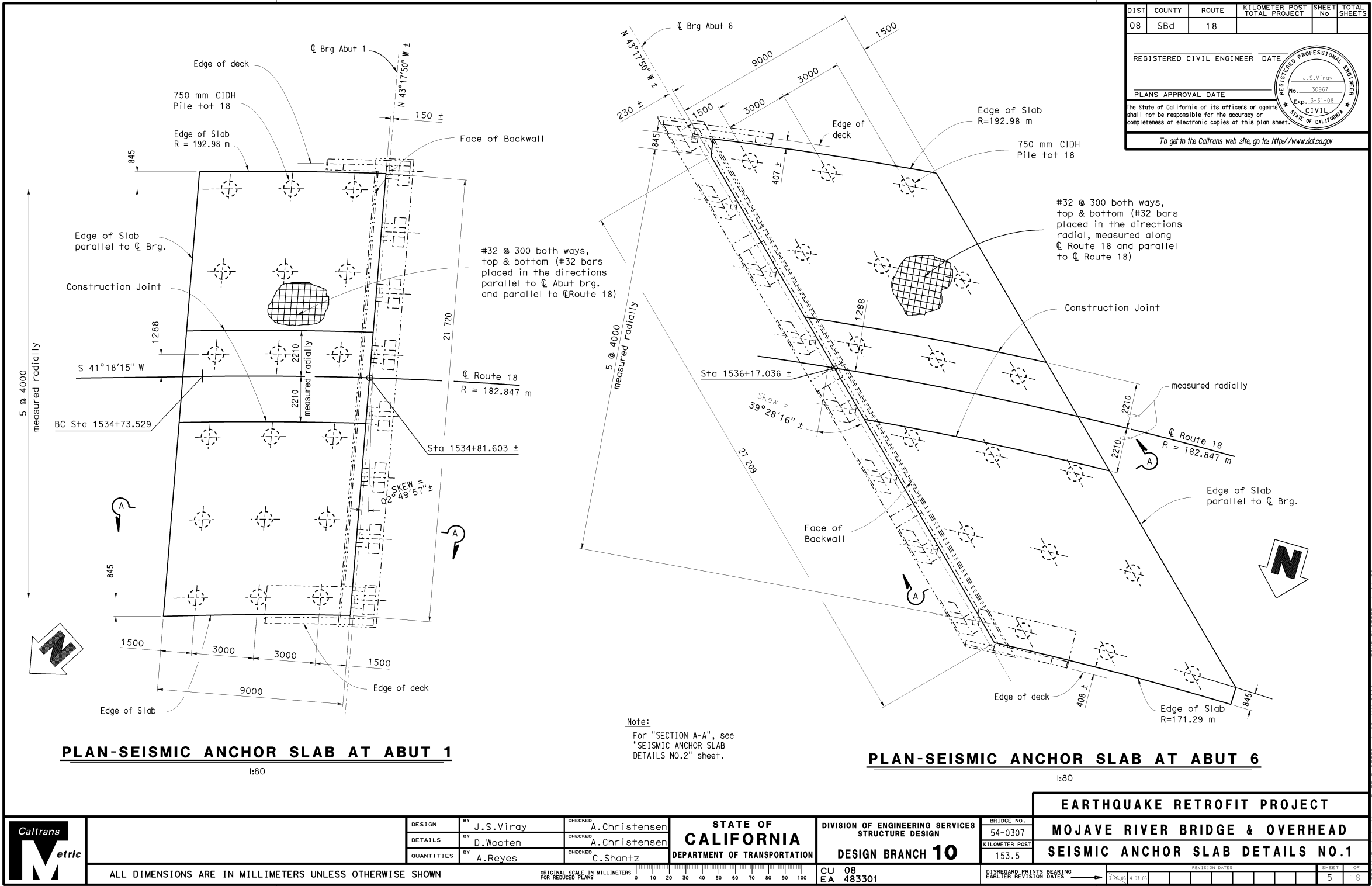
Also, Note 1 indicates the controlling stations and bearing values are plus/minus. For more information on the use of plus/minus dimensions see, “BDD SECTION 18 GUIDELINES FOR SEISMIC RETROFITS, 18.1.1 DEPENDANT DIMENSION AND THE USE OF THE PLUS/MINUS SYMBOL” Be aware of utility lines. A 24” diameter utility is generally shown on plans a single line, relying proper call-outs and as-built readability for identification.

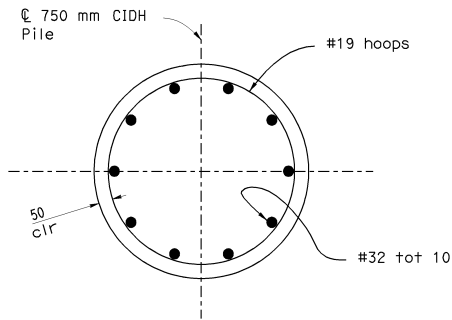






Note that this example refers directly to the “FOUNDATION PLAN” example shown as Figure 18-4.1. Using standard practice, the Anchor Slab has been located by station indicating its relationship to the existing structure. The example below has all the data necessary to layout the Anchor Slabs and produce accurate quantities.





SECTION C-C

Notes:

1. All hoops are "Ultimate" butt spliced continuous.
2. No splices are allowed in main CIDH pile reinforcement.

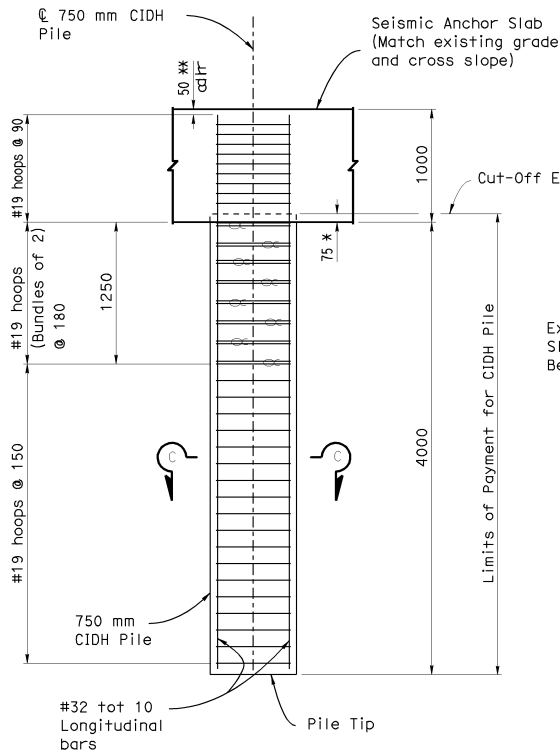
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08	SBd	18			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

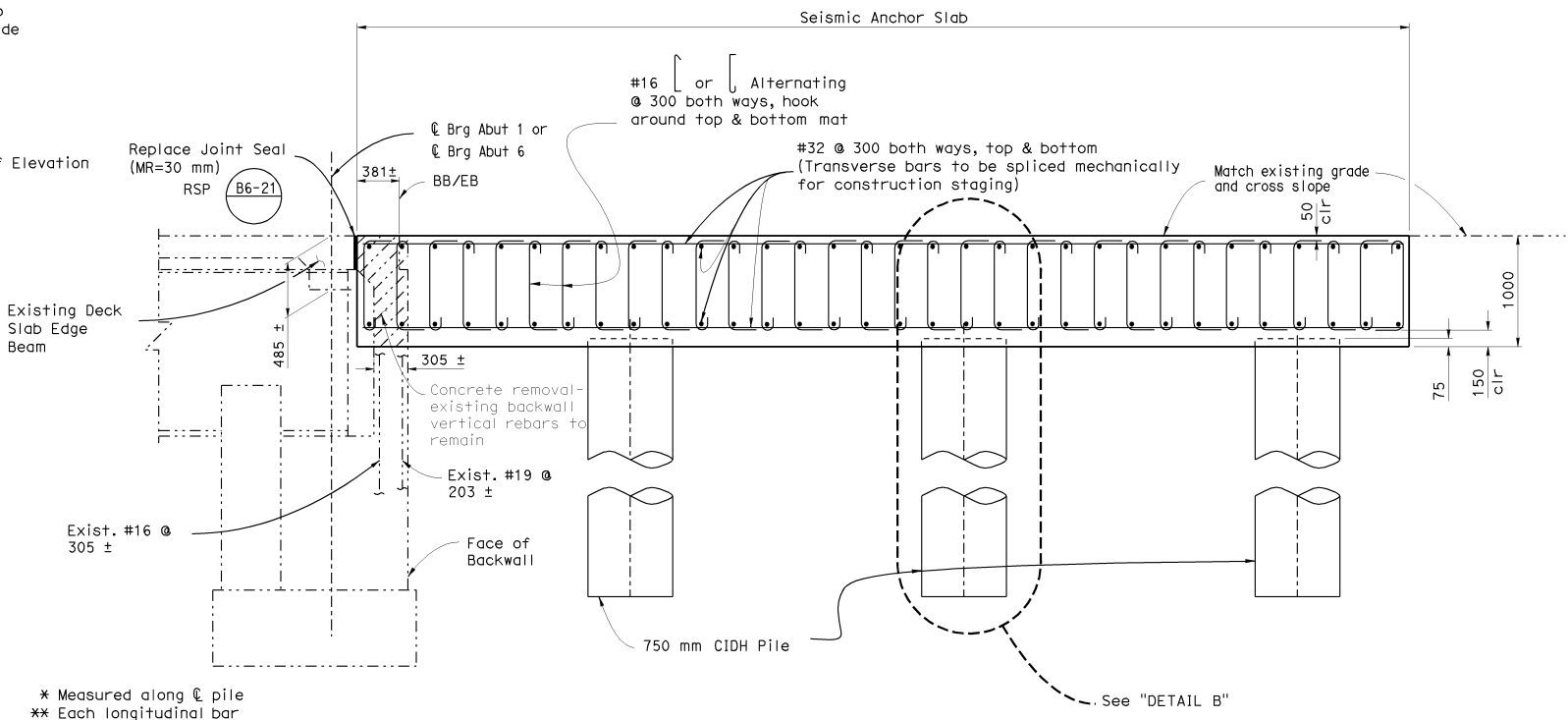
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To get to the Caltrans web site, go to: <http://www.dot.ca.gov>



DETAIL B

* Measured along ϕ pile
** Each longitudinal bar



SECTION A-A

Indicates Concrete Removal



DESIGN	BY J.S. Viray	CHECKED A. Christensen
DETAILS	BY D. Wooten	CHECKED A. Christensen
QUANTITIES	BY A. Reyes	CHECKED C. Shantz

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH 10

BRIDGE NO. 54-0307
KILOMETER POST 153.5

EARTHQUAKE RETROFIT PROJECT
MOJAVE RIVER BRIDGE & OVERHEAD
SEISMIC ANCHOR SLAB DETAILS NO. 2

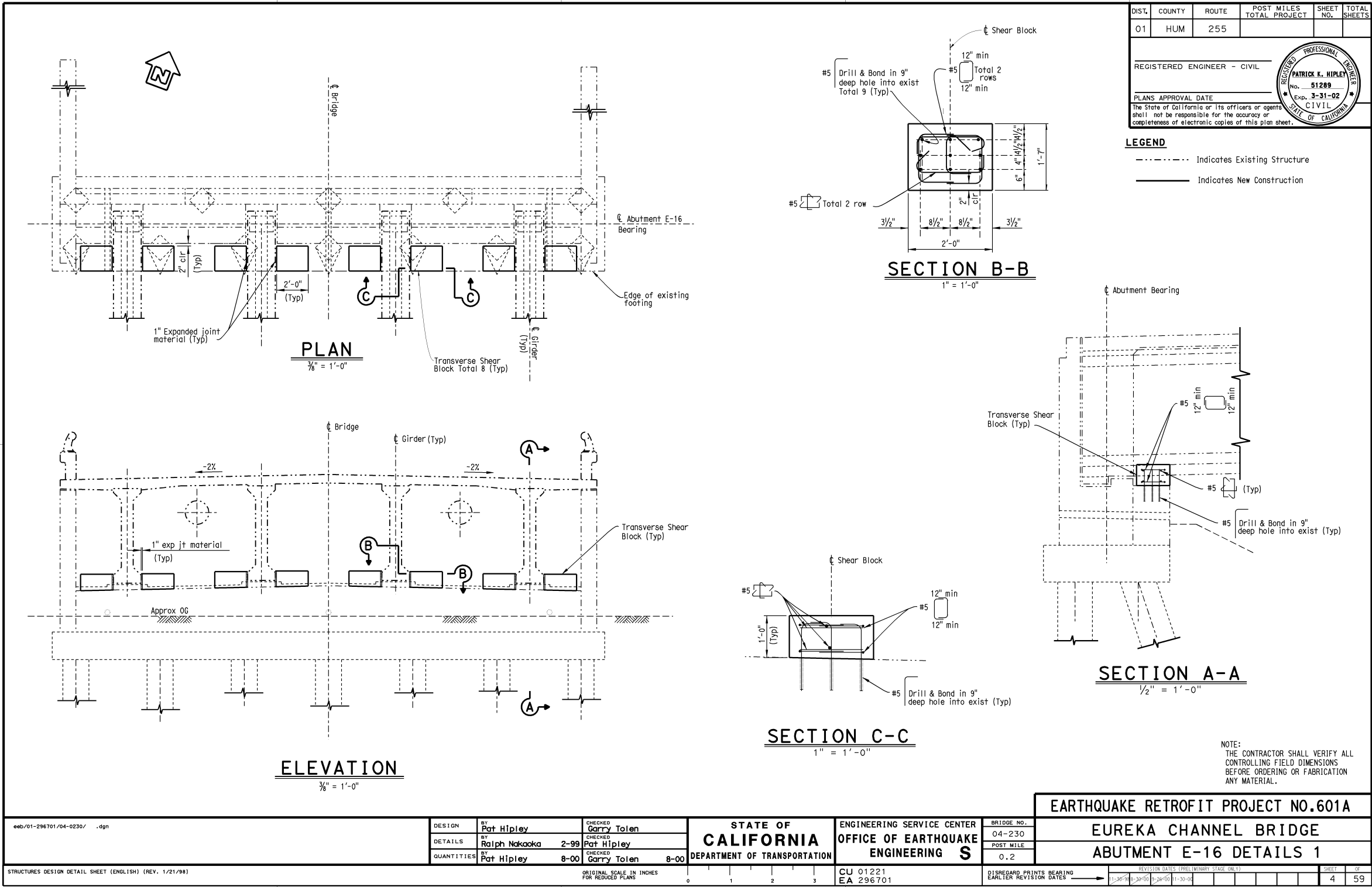
CU 08
EA 483301

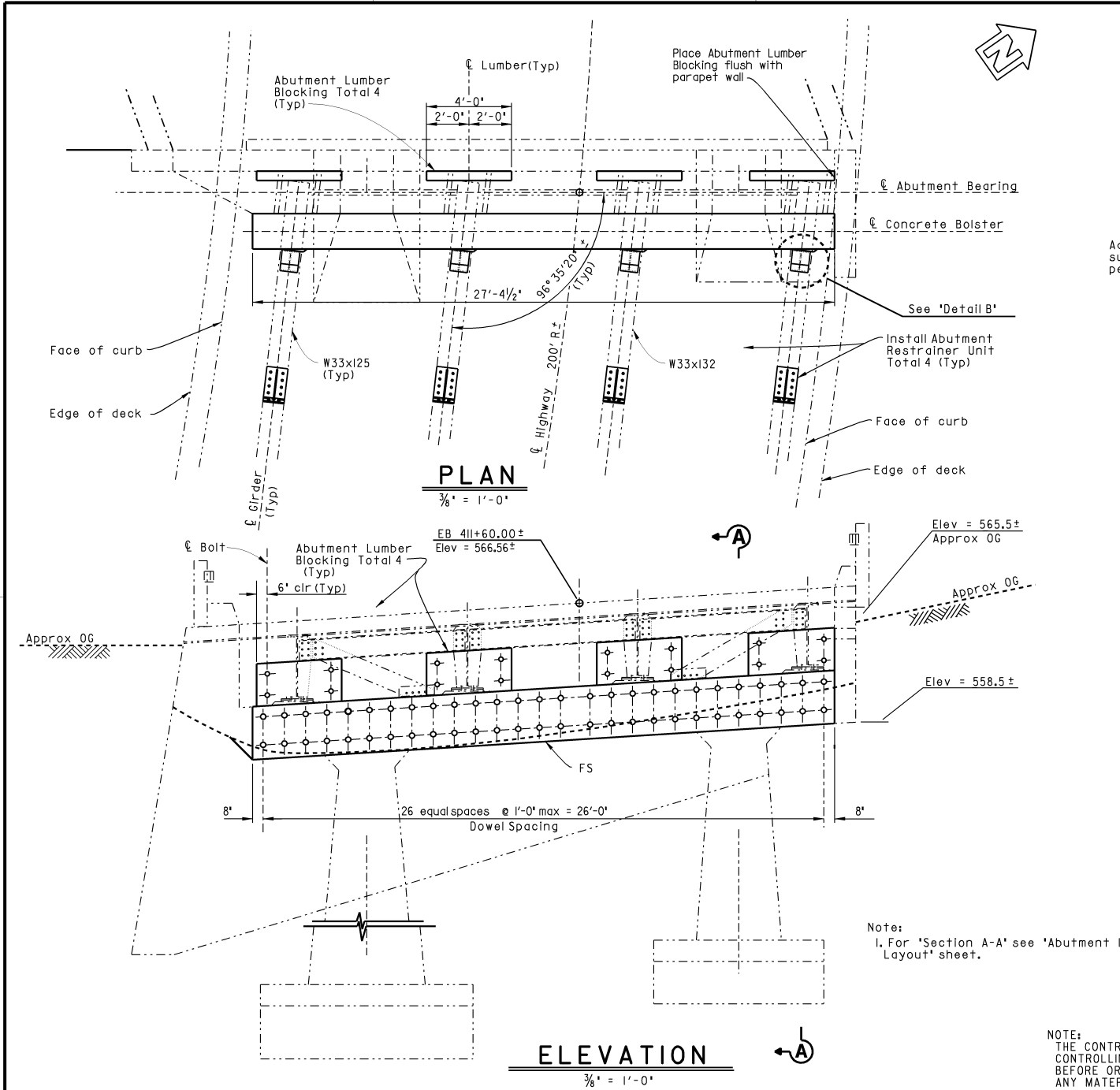
DISREGARD PRINTS BEARING
EARLIER REVISION DATES

REVISION DATES	SHEET	OF
1-97-98	6	18

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV. 03-17-04)

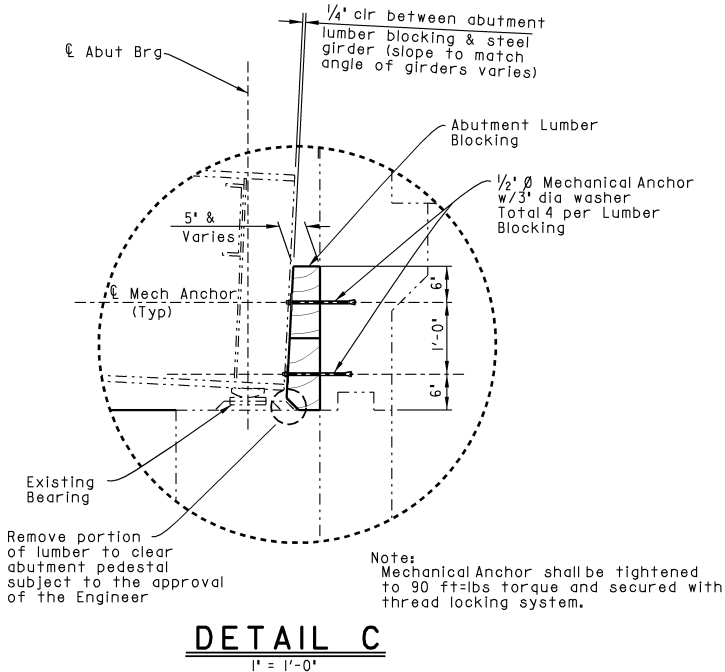
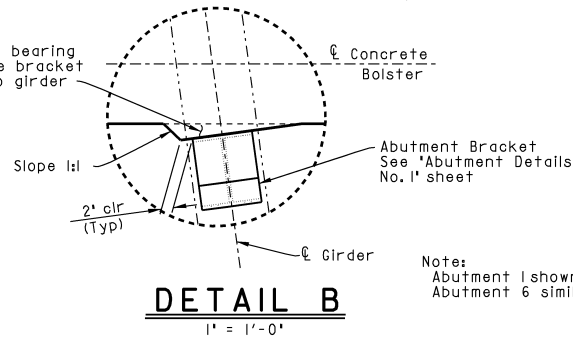
This example shows a relatively simple retrofit of adding shear blocks to a precast I-Girder abutment.





LEGEND

- Indicates Existing Structure
- Indicates New Construction



DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
05					

REGISTERED ENGINEER - CIVIL

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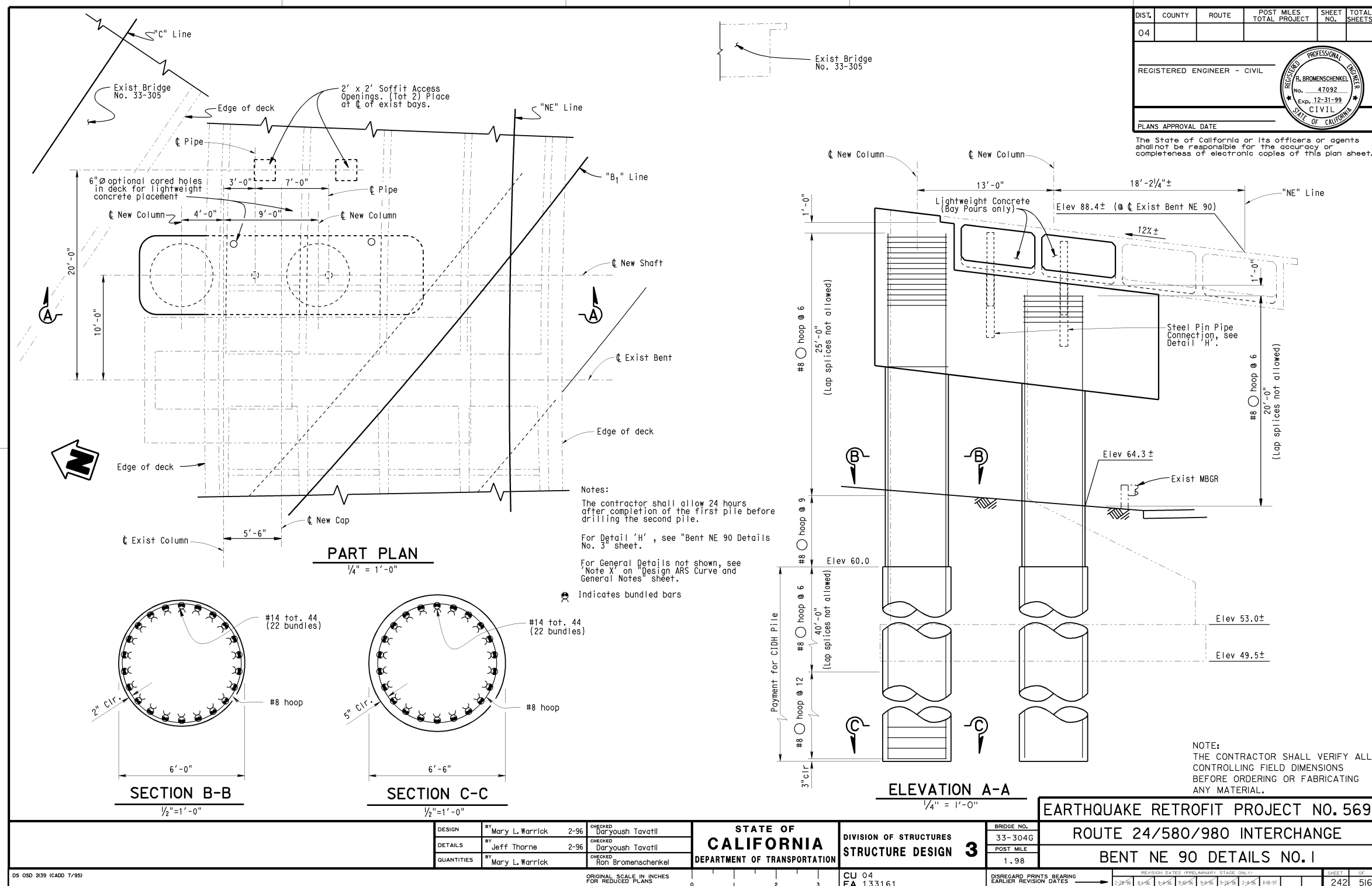
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DETAILS		BY Ralph Nakagawa	9-96	CHECKED Mark Yashinsky	9-96						
QUANTITIES		BY Pat Hipley	9-96	CHECKED Mark Yashinsky	9-96						

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

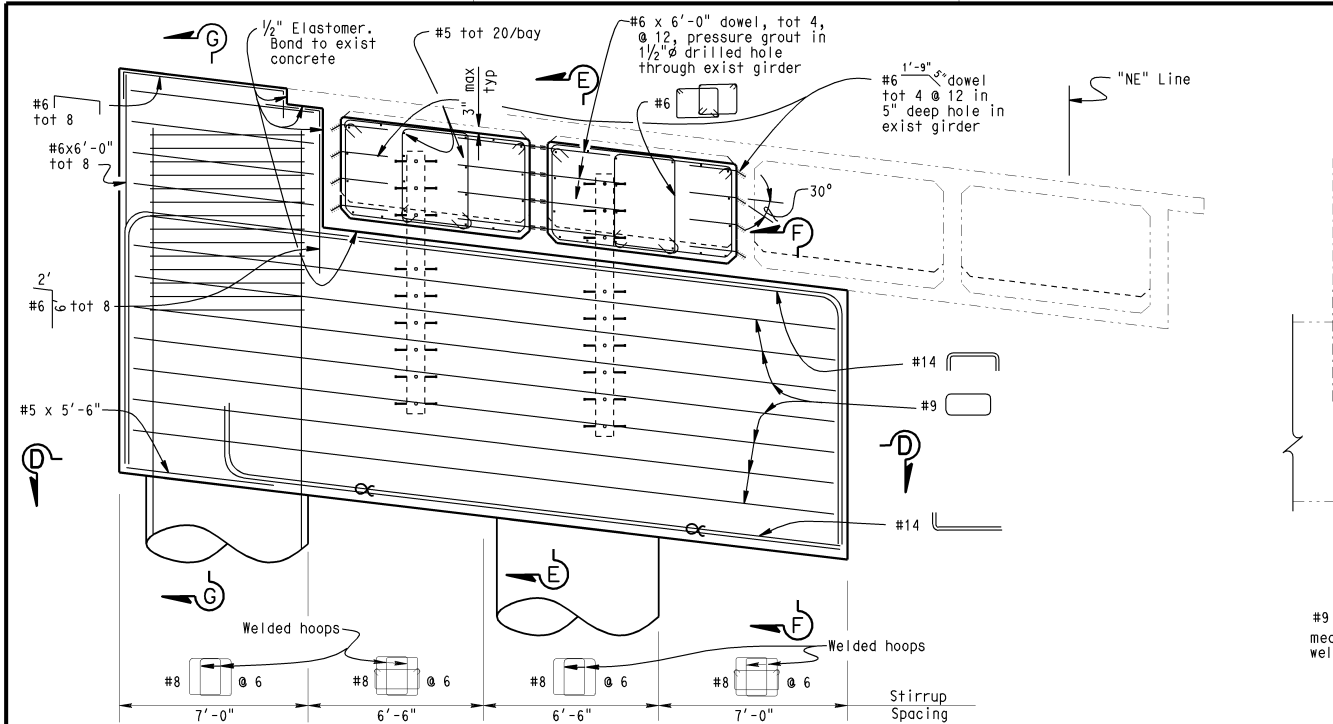
CU 06233
EA 430201

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035ab106.dgn

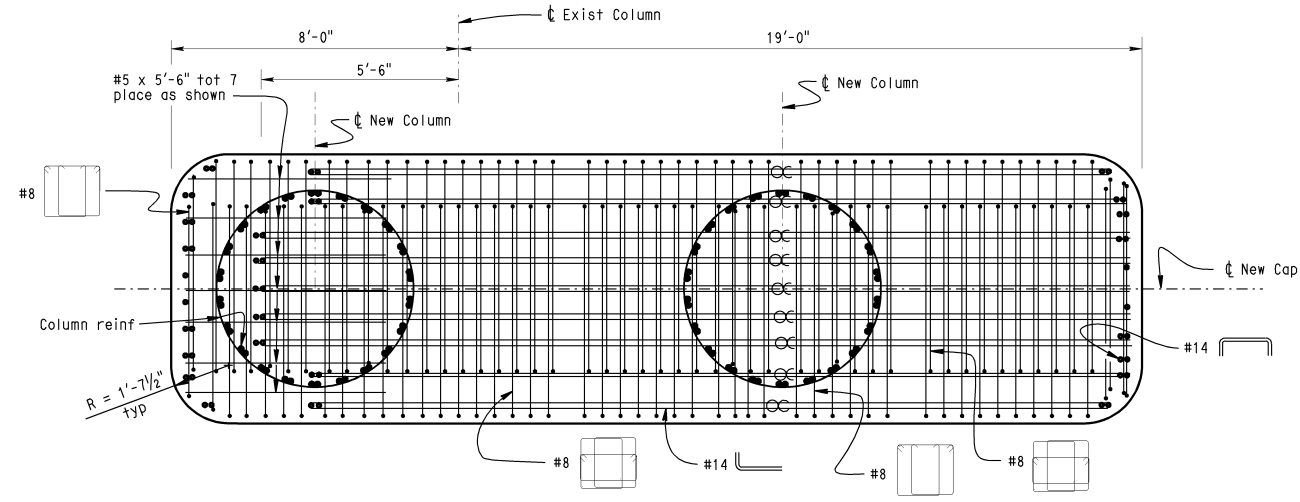


This example illustrates a very extreme retrofit strategy. The addition of a “bent like” structure, with CIDH piles for support.



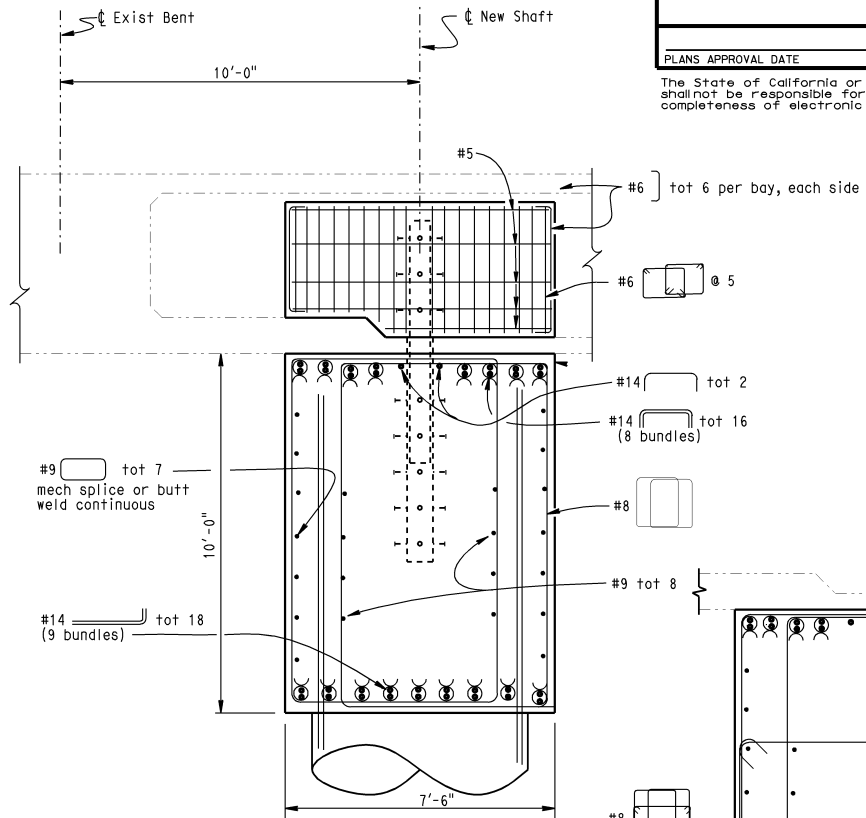
PART ELEVATION

3/8" = 1'-0"



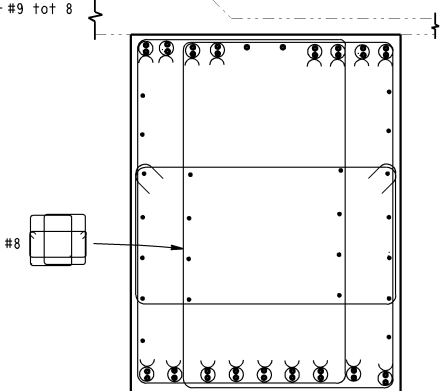
SECTION D - D

1/2" = 1'-0"



SECTION E-E

1/2" = 1'-0"



SECTION F-F

1/2" = 1'-0"

Note:
⊗ Indicates bundled bars

For 'Section G-G', see "Bent NE 90 Details No. 3" sheet.
For details not shown, see 'Section E - E'

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04					

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DS OSD 239 (CADD 7/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 3

BRIDGE NO.
33-304G
POST MILE
1.98

EARTHQUAKE RETROFIT PROJECT NO. 569

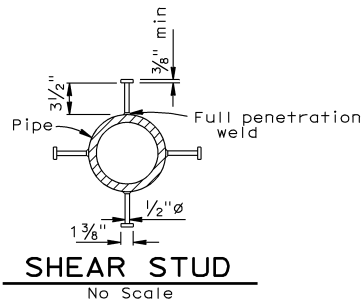
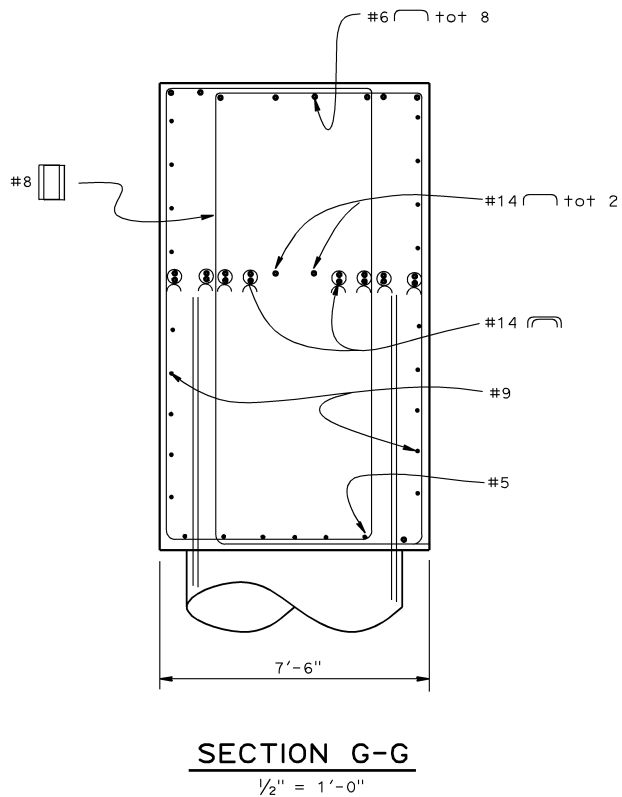
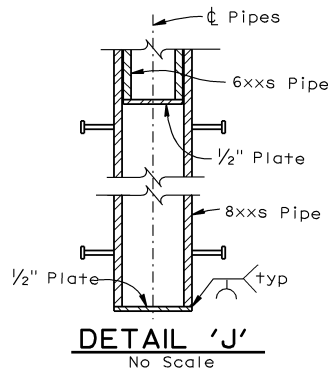
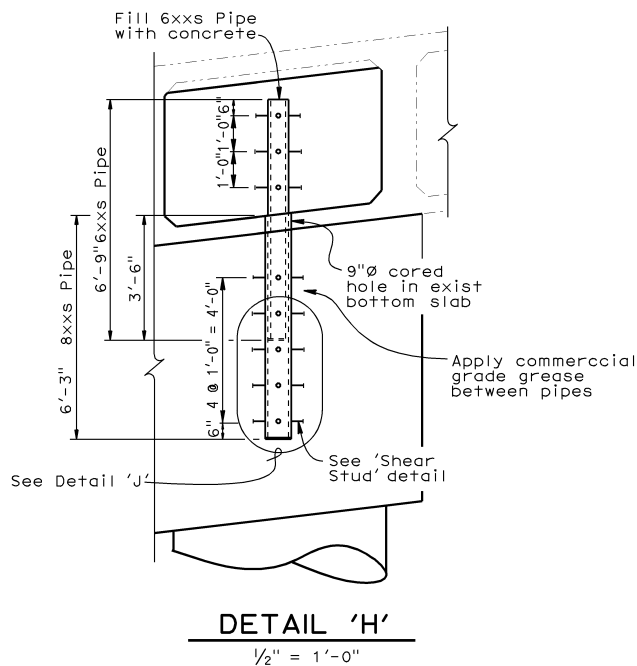
ROUTE 24/580/980 INTERCHANGE

BENT NE 90 DETAILS NO. 2

CU 04
EA 133161

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)										SHEET	OF
1	2	3	4	5	6	7	8	9	10	243	516



DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04					

REGISTERED ENGINEER - CIVIL

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PROFESSIONAL ENGINEER
R. BROMENSCHENKEL
No. 47092
Exp. 12-31-99
CIVIL
STATE OF CALIFORNIA

NOTE:
THE CONTRACTOR SHALL VERIFY ALL
CONTROLLING FIELD DIMENSIONS
BEFORE ORDERING OR FABRICATING
ANY MATERIAL.

EARTHQUAKE RETROFIT PROJECT NO. 569

ROUTE 24/580/980 INTERCHANGE
BENT NE 90 DETAILS NO. 3

DESIGN	BY	CHECKED	DATE	STATE OF CALIFORNIA	DIVISION OF STRUCTURES	BRIDGE NO.	POST MILE	REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	OF
DESIGN	Mary L. Warrick	2-96	Daryoush Tavatli	STATE OF CALIFORNIA	DIVISION OF STRUCTURES	33-304G	1.98	1-98-37	244	516
DETAILS	Jeff Thorne	2-96	Daryoush Tavatli	DEPARTMENT OF TRANSPORTATION	STRUCTURE DESIGN 3					
QUANTITIES	Mary L. Warrick		Ron Bromenschenkel							

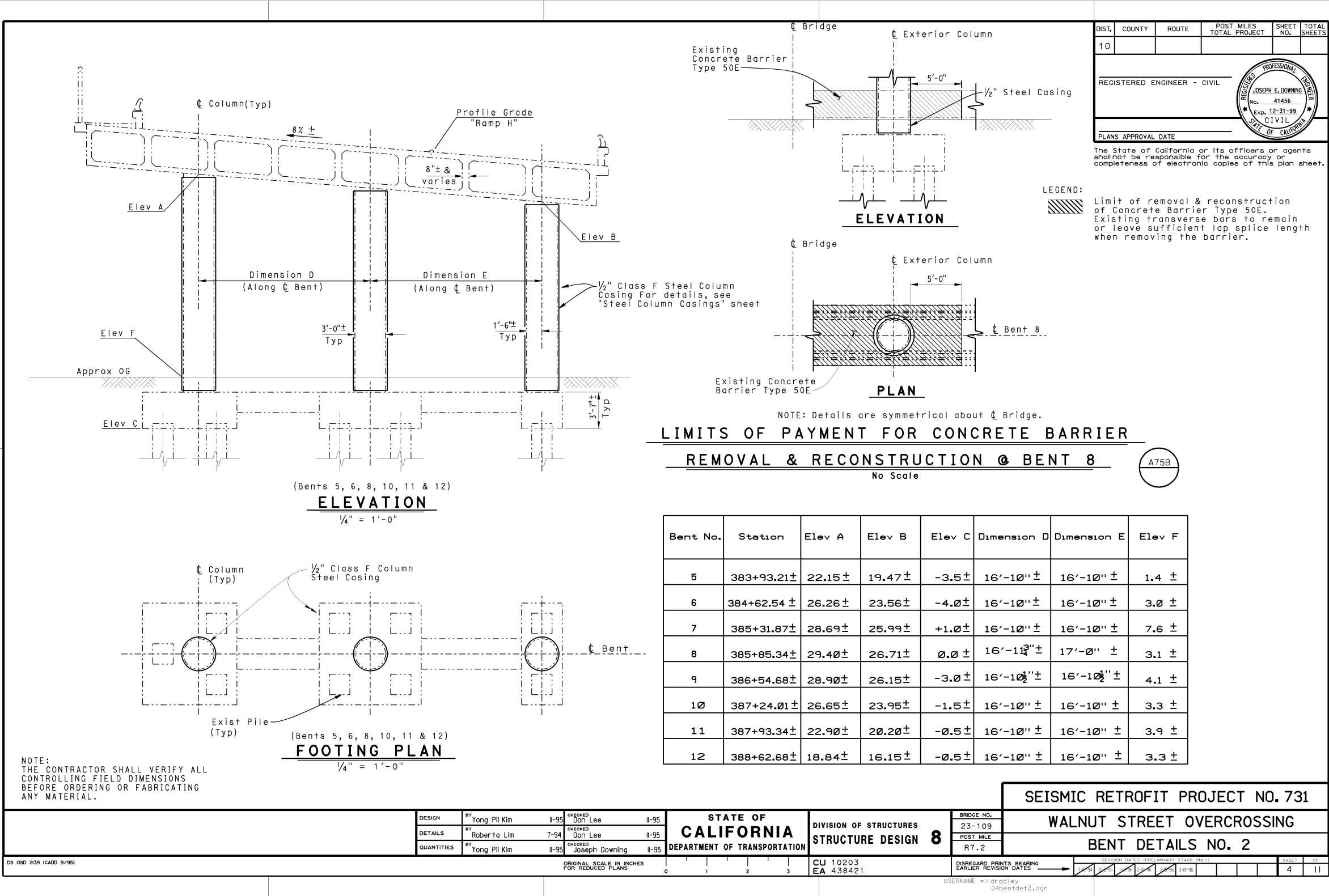
CU 04
EA 133161

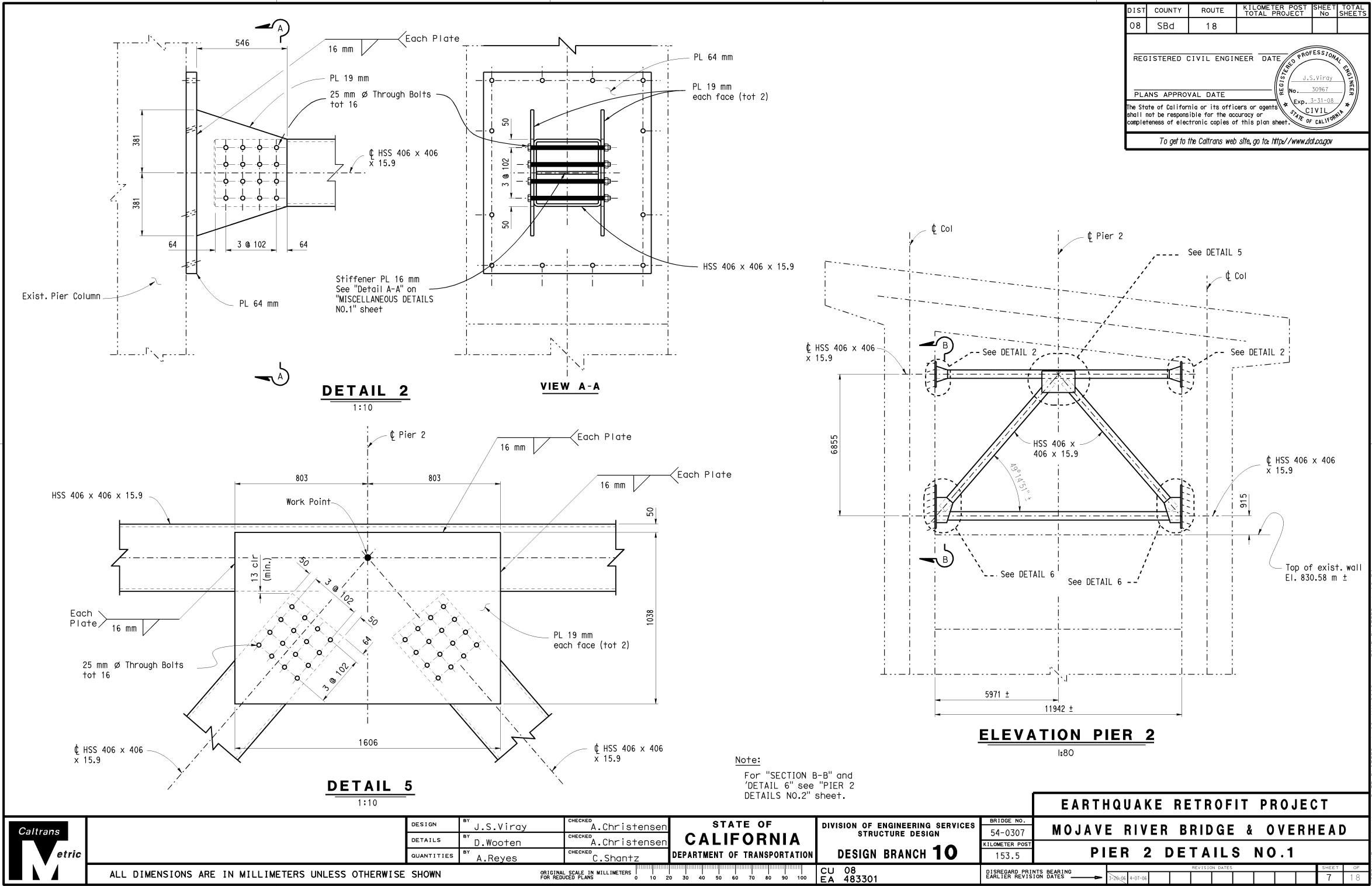
DISREGARD PRINTS BEARING
EARLIER REVISION DATES

ORIGINAL SCALE IN INCHES
FOR REDUCED PLANS

0 1 2 3

Here we have much simpler retrofit, the application of steel jackets to round columns. Note there is an existing TYPE 50 barrier that must be modified. Again, Concrete Removal Details are shown. The chart provides necessary elevations that allow lengths of specific jackets to be calculated for quantities and fabrication.

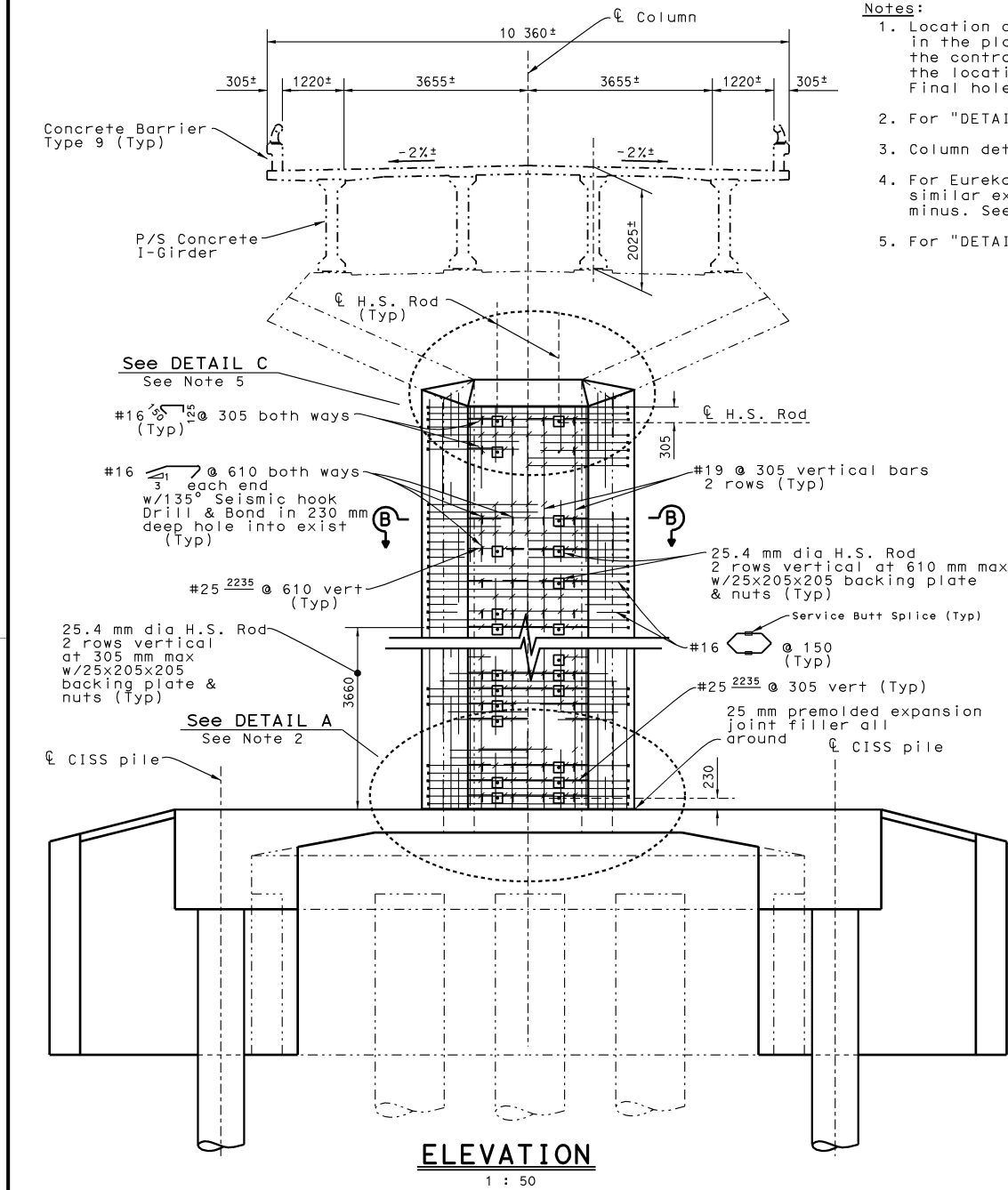




The next two pages support a pier retrofit.
This retrofit uses a steel 'braced frame' as opposed to a concrete in-fill wall to tie the columns together. See Figure 18-1.2 (BDA 14-5.3)

These assembly details support the layout shown previously as BBD 18-7.2. Adequate dimensions and member sizes shown ensure accurate QUANTITIES.

This plus the following 2 examples show a very complex column retrofit. Read ‘Note 1’. Extra care should be taken in preparation of as-built base drawings like these. The location of existing reinforcement is difficult to ascertain, but accurate base drawings provide the best opportunity for success.



Notes:

1. Location of drilled dowel and high strength rod holes shown in the plans are approximate. Prior to coring holes in concrete the contractor shall locate all reinforcing steel and adjust the location of the holes to clear all reinforcing bars. Final hole locations are subject to the approval of the Engineer.
2. For "DETAIL A" details, see "COLUMN DETAIL 2" sheet.
3. Column details shown are for all piers except Piers E-7 & E-8 sheet
4. For Eureka Channel Bridge Piers E-7 and E-8 reinforcement are similar except the existing column sizes are 1525x3660 plus or minus. See "COLUMN DETAIL 2" sheet.
5. For "DETAIL C" details, see "COLUMN DETAIL 3" sheet.



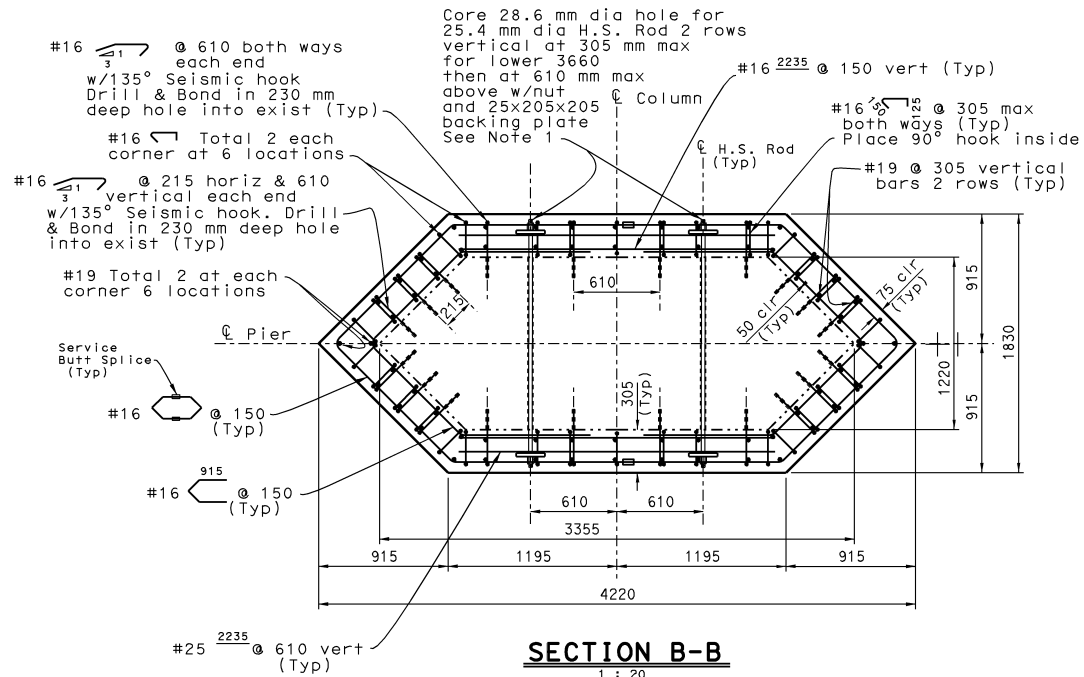
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
01	HUM	255	0.1/3.1	73	140

REGISTERED CIVIL ENGINEER
PATRICK K. HIPLEY
No. 51289
Exp. 3-31-06
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.
Caltrans now has a web site! To get to the web site, go to: <http://www.dot.ca.gov>

LEGEND

- Indicates Existing Structure
————— Indicates New Construction



NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

EARTHQUAKE RETROFIT PROJECT NO.601A

EUREKA CHANNEL BRIDGE

COLUMN DETAIL 1

DESIGN	BY Fadel Alameddine	CHECKED Garry Tolen
DETAILS	BY Ralph Nakaoka	CHECKED Pat Hipley
QUANTITIES	BY Pat Hipley	CHECKED Tolen /Woodruff

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

ENGINEERING SERVICE CENTER
OFFICE OF EARTHQUAKE ENGINEERING

BRIDGE NO.	04-230
KILOMETER POST	0.32

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV. 3/1/99)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS

CU 01221
EA 296701

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

1/1/00 1/1/01 1/1/02 1/1/03 1/1/04 1/1/05 1/1/06 1/1/07 1/1/08 1/1/09 1/1/10 1/1/11 1/1/12 1/1/13 1/1/14 1/1/15 1/1/16 1/1/17 1/1/18 1/1/19 1/1/20 1/1/21 1/1/22 1/1/23 1/1/24 1/1/25 1/1/26 1/1/27 1/1/28 1/1/29 1/1/30 1/1/31 1/1/32 1/1/33 1/1/34 1/1/35 1/1/36 1/1/37 1/1/38 1/1/39 1/1/40 1/1/41 1/1/42 1/1/43 1/1/44 1/1/45 1/1/46 1/1/47 1/1/48 1/1/49 1/1/50 1/1/51 1/1/52 1/1/53 1/1/54 1/1/55 1/1/56 1/1/57 1/1/58 1/1/59 1/1/60 1/1/61 1/1/62 1/1/63 1/1/64 1/1/65 1/1/66 1/1/67 1/1/68 1/1/69 1/1/70 1/1/71 1/1/72 1/1/73 1/1/74 1/1/75 1/1/76 1/1/77 1/1/78 1/1/79 1/1/80 1/1/81 1/1/82 1/1/83 1/1/84 1/1/85 1/1/86 1/1/87 1/1/88 1/1/89 1/1/90 1/1/91 1/1/92 1/1/93 1/1/94 1/1/95 1/1/96 1/1/97 1/1/98 1/1/99 1/1/00 1/1/01 1/1/02 1/1/03 1/1/04 1/1/05 1/1/06 1/1/07 1/1/08 1/1/09 1/1/10 1/1/11 1/1/12 1/1/13 1/1/14 1/1/15 1/1/16 1/1/17 1/1/18 1/1/19 1/1/20 1/1/21 1/1/22 1/1/23 1/1/24 1/1/25 1/1/26 1/1/27 1/1/28 1/1/29 1/1/30 1/1/31 1/1/32 1/1/33 1/1/34 1/1/35 1/1/36 1/1/37 1/1/38 1/1/39 1/1/40 1/1/41 1/1/42 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1/1/01 1/1/02 1/1/03 1/1/04 1/1/05 1/1/06 1/1/07 1/1/08 1/1/09 1/1/10 1/1/11 1/1/12 1/1/13 1/1/14 1/1/15 1/1/16 1/1/17 1/1/18 1/1/19 1/1/20 1/1/21 1/1/22 1/1/23 1/1/24 1/1/25 1/1/26 1/1/27 1/1/28 1/1/29 1/1/30 1/1/31 1/1/32 1/1/33 1/1/34 1/1/35 1/1/36 1/1/37 1/1/38 1/1/39 1/1/40 1/1/41 1/1/42 1/1/43 1/1/44 1/1/45 1/1/46 1/1/47 1/1/48 1/1/49 1/1/50 1/1/51 1/1/52 1/1/53 1/1/54 1/1/55 1/1/56 1/1/57 1/1/58 1/1/59 1/1/60 1/1/61 1/1/62 1/1/63 1/1/64 1/1/65 1/1/66 1/1/67 1/1/68 1/1/69 1/1/70 1/1/71 1/1/72 1/1/73 1/1/74 1/1/75 1/1/76 1/1/77 1/1/78 1/1/79 1/1/80 1/1/81 1/1/82 1/1/83 1/1/84 1/1/85 1/1/86 1/1/87 1/1/88 1/1/89 1/1/90 1/1/91 1/1/92 1/1/93 1/1/94 1/1/95 1/1/96 1/1/97 1/1/98 1/1/99 1/1/00 1/1/01 1/1/02 1/1/03 1/1/04 1/1/05 1/1/06 1/1/07 1/1/08 1/1/09 1/1/10 1/1/11 1/1/12 1/1/13 1/1/14 1/1/15 1/1/16 1/1/17 1/1/18 1/1/19 1/1/20 1/1/21 1/1/22 1/1/23 1/1/24 1/1/25 1/1/26 1/1/27 1/1/28 1/1/29 1/1/30 1/1/31 1/1/32 1/1/33 1/1/34 1/1/35 1/1/36 1/1/37 1/1/38 1/1/39 1/1/40 1/1/41 1/1/42 1/1/43 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1/1/87 1/1/88 1/1/89 1/1/90 1/1/91 1/1/92 1/1/93 1/1/94 1/1/95 1/1/96 1/1/97 1/1/98 1/1/99 1/1/00 1/1/01 1/1/02 1/1/03 1/1/04 1/1/05 1/1/06 1/1/07 1/1/08 1/1/09 1/1/10 1/1/11 1/1/12 1/1/13 1/1/14 1/1/15 1/1/16 1/1/17 1/1/18 1/1/19 1/1/20 1/1/21 1/1/22 1/1/23 1/1/24 1/1/25 1/1/26 1/1/27 1/1/28 1/1/29 1/1/30 1/1/31 1/1/32 1/1/33 1/1/34 1/1/35 1/1/36 1/1/37 1/1/38 1/1/39 1/1/40 1/1/41 1/1/42 1/1/43 1/1/44 1/1/45 1/1/46 1/1/47 1/1/48 1/1/49 1/1/50 1/1/51 1/1/52 1/1/53 1/1/54 1/1/55 1/1/56 1/1/57 1/1/58 1/1/59 1/1/60 1/1/61 1/1/62 1/1/63 1/1/64 1/1/65 1/1/66 1/1/67 1/1/68 1/1/69 1/1/70 1/1/71 1/1/72 1/1/73 1/1/74 1/1/75 1/1/76 1/1/77 1/1/78 1/1/79 1/1/80 1/1/81 1/1/82 1/1/83 1/1/84 1/1/85 1/1/86 1/1/87 1/1/88 1/1/89 1/1/90 1/1/91 1/1/92 1/1/93 1/1/94 1/1/95 1/1/96 1/1/97 1/1/98 1/1/99 1/1/00 1/1/01 1/1/02 1/1/03 1/1/04 1/1/05 1/1/06 1/1/07 1/1/08 1/1/09 1/1/10 1/1/11 1/1/12 1/1/13 1/1/14 1/1/15 1/1/16 1/1/17 1/1/18 1/1/19 1/1/20 1/1/21 1/1/22 1/1/23 1/1/24 1/1/25 1/1/26 1/1/27 1/1/28 1/1/29 1/1/30 1/1/31 1/1/32 1/1/3

- Notes:
1. For "DETAIL A" location see "COLUMN DETAIL 1" sheet.
 2. For clarity footing reinforcement not shown.
 3. Precast concrete skirt not shown.



DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
01	HUM	255	0.1/3.1	74	140

01-02-01

REGISTERED CIVIL ENGINEER

11-25-02

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

Caltrans now has a web site! To get to the web site, go to: <https://www.dot.ca.gov>

REGISTERED PROFESSIONAL ENGINEER

PATRICK K. HIPLEY

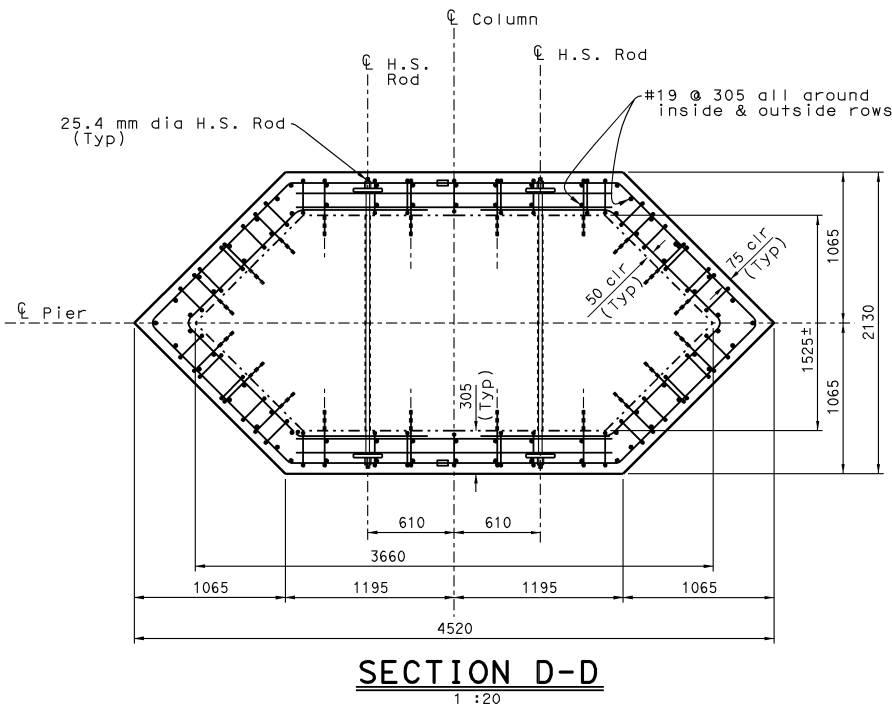
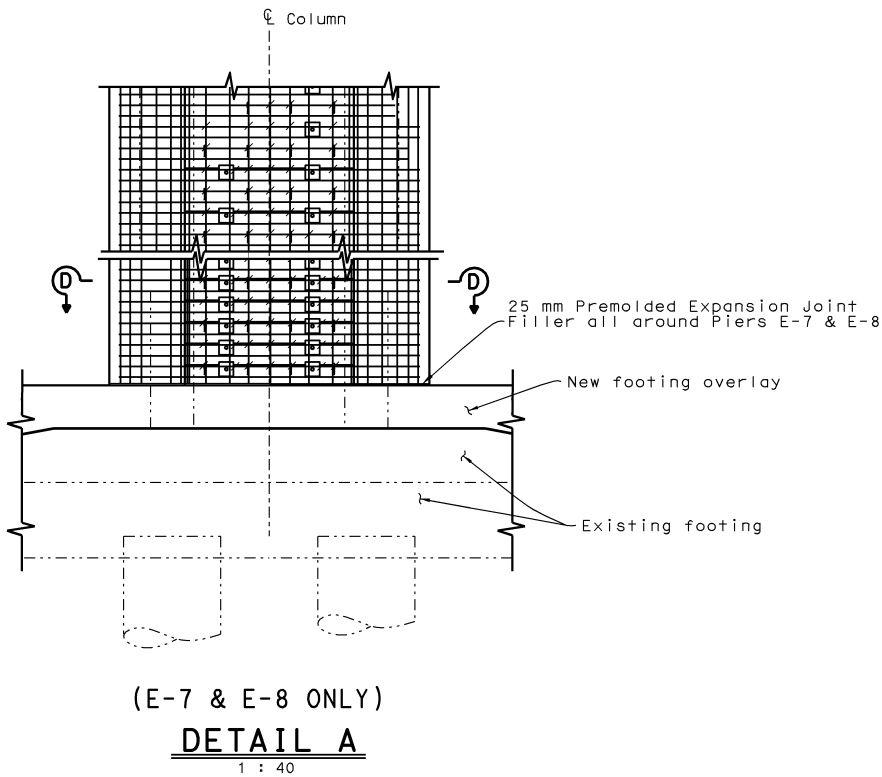
No. 51289

Exp. 3-31-06

CIVIL

STATE OF CALIFORNIA

- LEGEND
- Indicates Existing Structure
 - Indicates New Construction



Note:
For additional reinforcement bar details,
see "SECTION B-B" in "COLUMN DETAIL 1" sheet.

NOTE:
THE CONTRACTOR SHALL VERIFY ALL
CONTROLLING FIELD DIMENSIONS
BEFORE ORDERING OR FABRICATING
ANY MATERIAL.

DESIGN	BY Fadel Alameddine	CHECKED Garry Tolen	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	ENGINEERING SERVICE CENTER	BRIDGE NO.	EARTHQUAKE RETROFIT PROJECT NO.601A EUREKA CHANNEL BRIDGE COLUMN DETAIL 2
DETAILS	BY Ralph Nakaoka	CHECKED Pat Hipley		OFFICE OF EARTHQUAKE ENGINEERING	04-230	
QUANTITIES	BY Pat Hipley	CHECKED Tolen /Woodruff		ENGINEERING S	0.32	

CU 01221
EA 296701

DISREGARD PRINTS BEARING
EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 24 OF 34

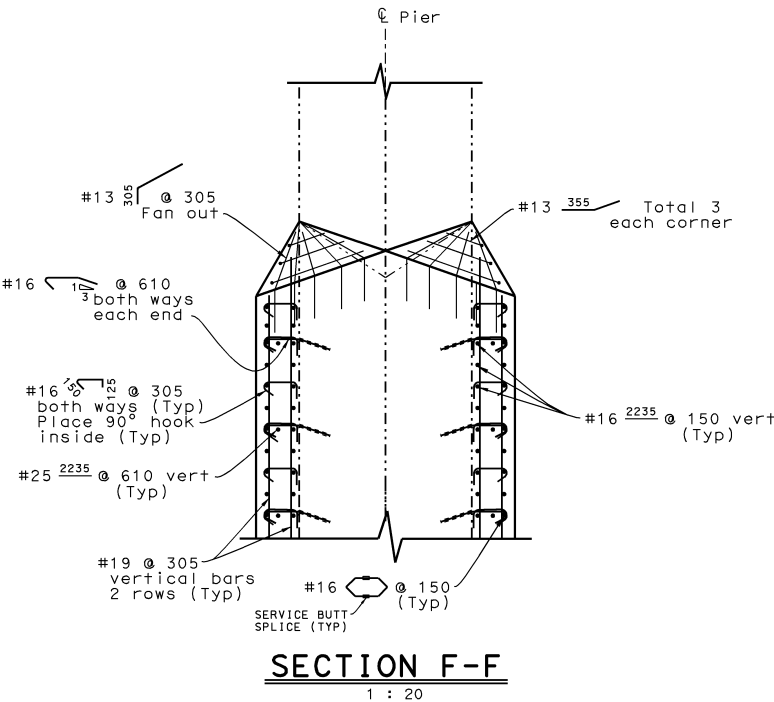
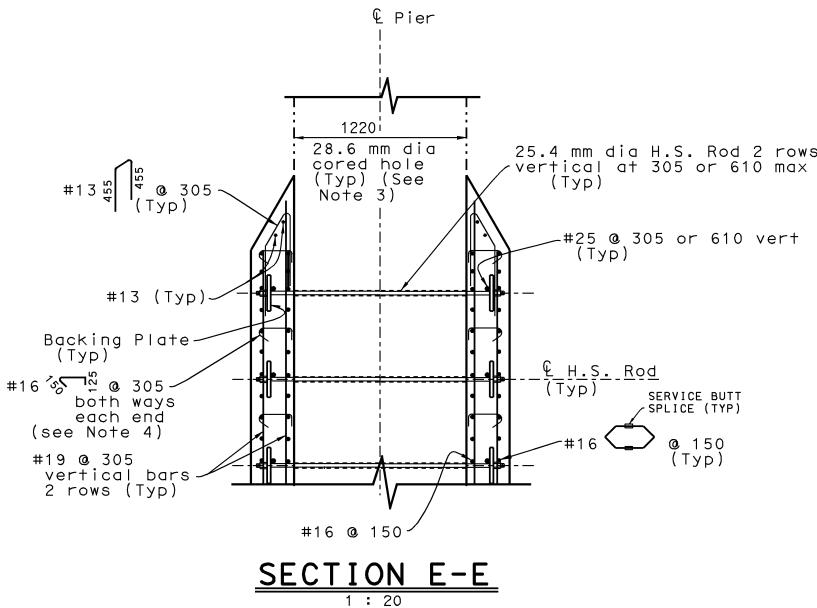
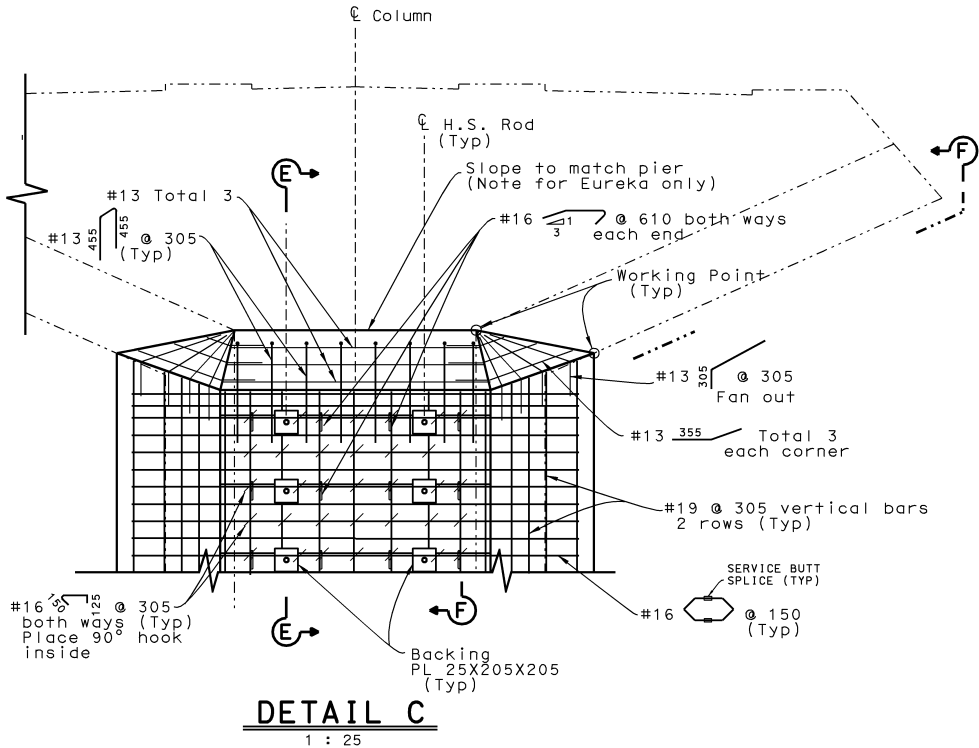
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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
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REGISTERED CIVIL ENGINEER					
PLANS APPROVAL DATE					
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Caltrans now has a web site! To get to the web site, go to: http://www.dot.ca.gov					

LEGEND

- Indicates Existing Structure
————— Indicates New Construction



NOTE:
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CONTROLLING FIELD DIMENSIONS
BEFORE ORDERING OR FABRICATING
ANY MATERIAL.

ALL DIMENSIONS ARE IN
MILLIMETERS UNLESS OTHERWISE SHOWN

EARTHQUAKE RETROFIT PROJECT NO.601A

EUREKA CHANNEL BRIDGE

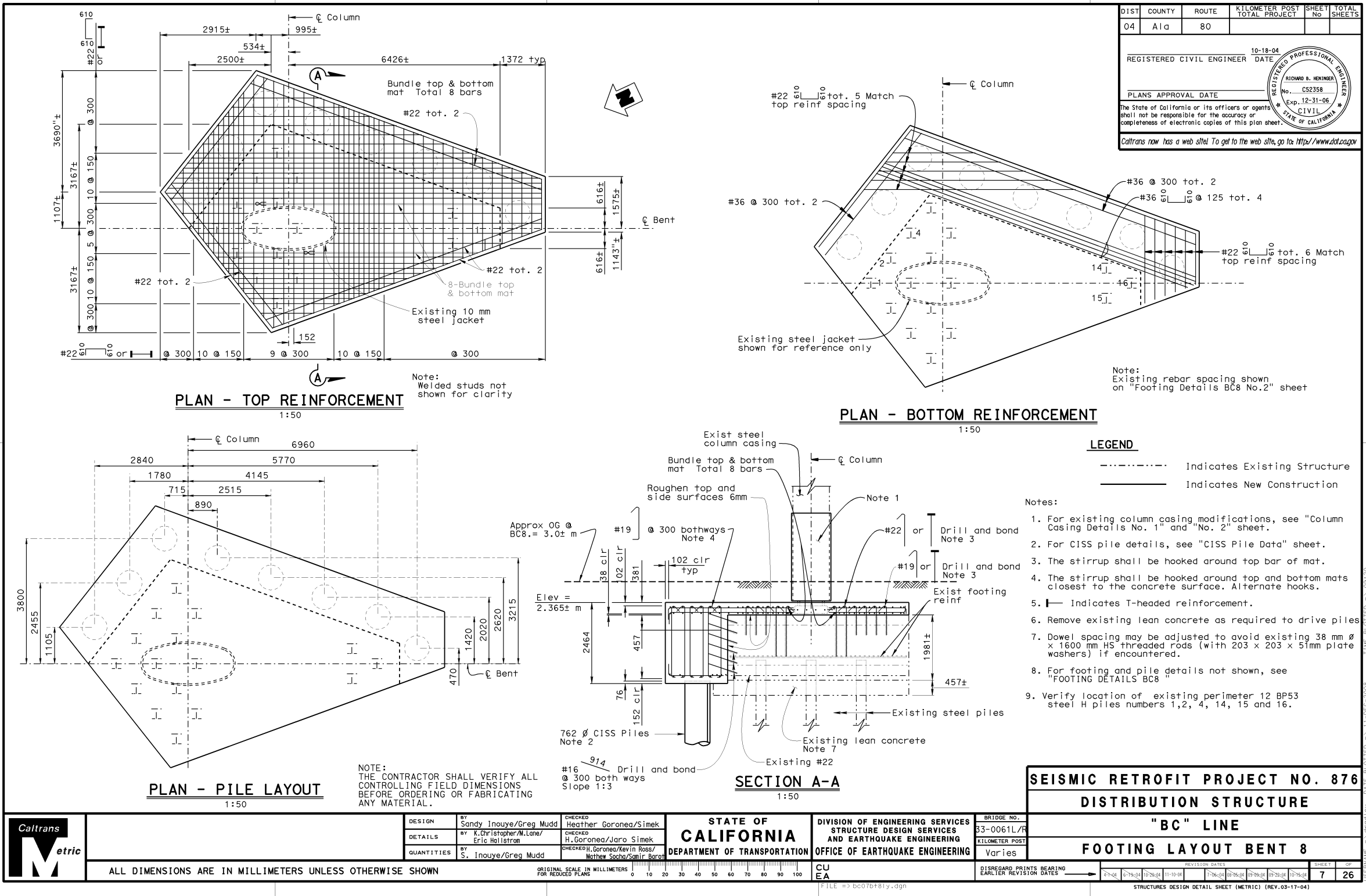
COLUMN DETAIL 3

DESIGN	BY Fadel Alameddine	CHECKED Garry Tolén	STATE OF CALIFORNIA	ENGINEERING SERVICE CENTER	BRIDGE NO.	04-230	REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	25	OF	34
DETAILS	BY Ralph Nakaoka	CHECKED Pat Hipley	DEPARTMENT OF TRANSPORTATION	OFFICE OF EARTHQUAKE ENGINEERING	KILOMETER POST	0.32	DISREGARD PRINTS BEARING EARLIER REVISION DATES				
QUANTITIES	BY Pat Hipley	CHECKED Tolén /Woodruff									

ORIGINAL SCALE IN MILLIMETERS
FOR REDUCED PLANS

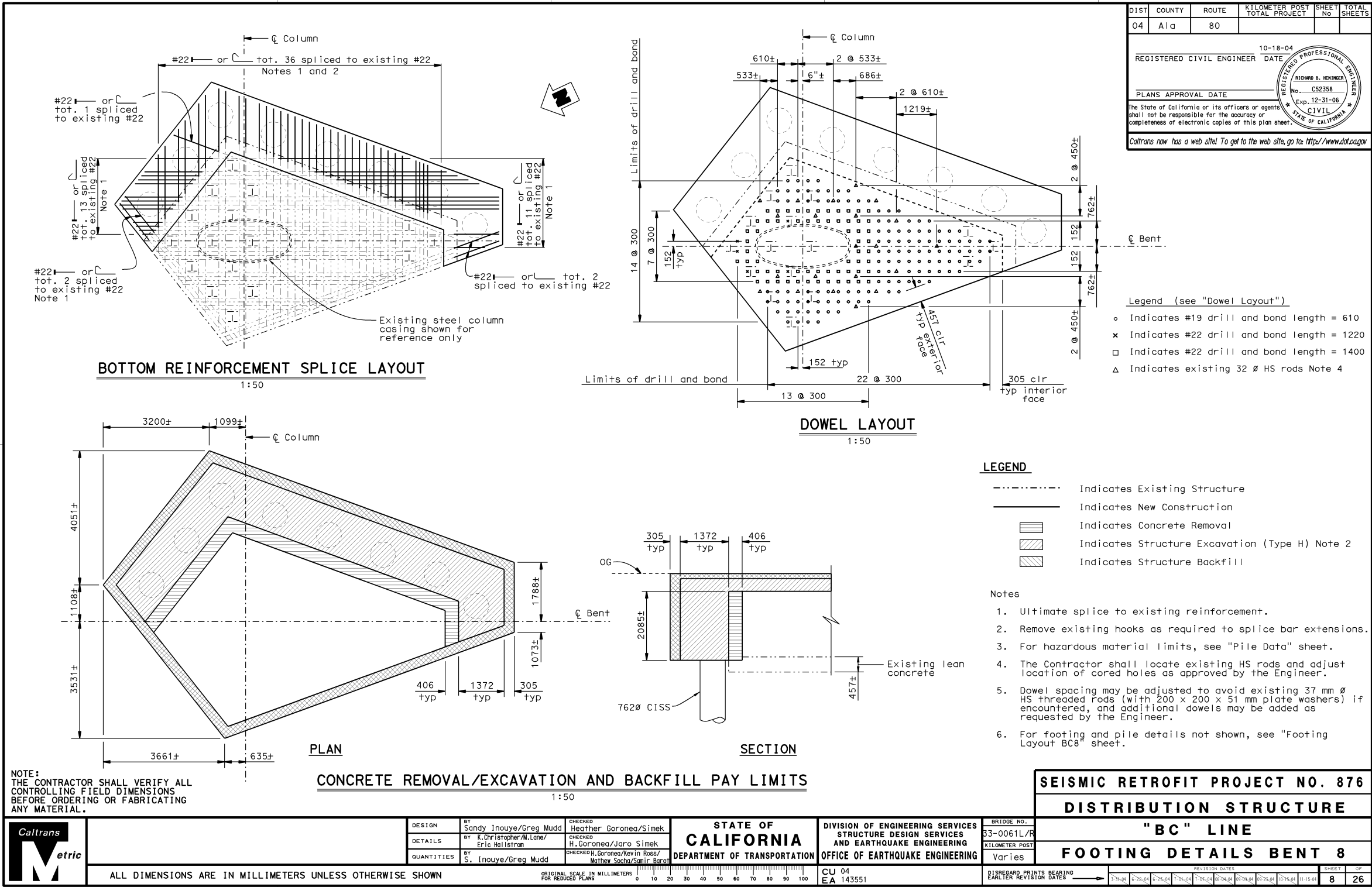
CU 01221
EA 296701
FILE => cdc0125cdt.dgn

TIME PLOTTED => 10:09
DATE PLOTTED => 26-FEB-2009
USERNAME => jrodrey



Note "SECTION A-A" provides much information on 'Drill and Bond Dowel'. The option of using standard dowels with hooks or "T-Headed" dowels is indicated. This helps open up congested areas of reinforcement.

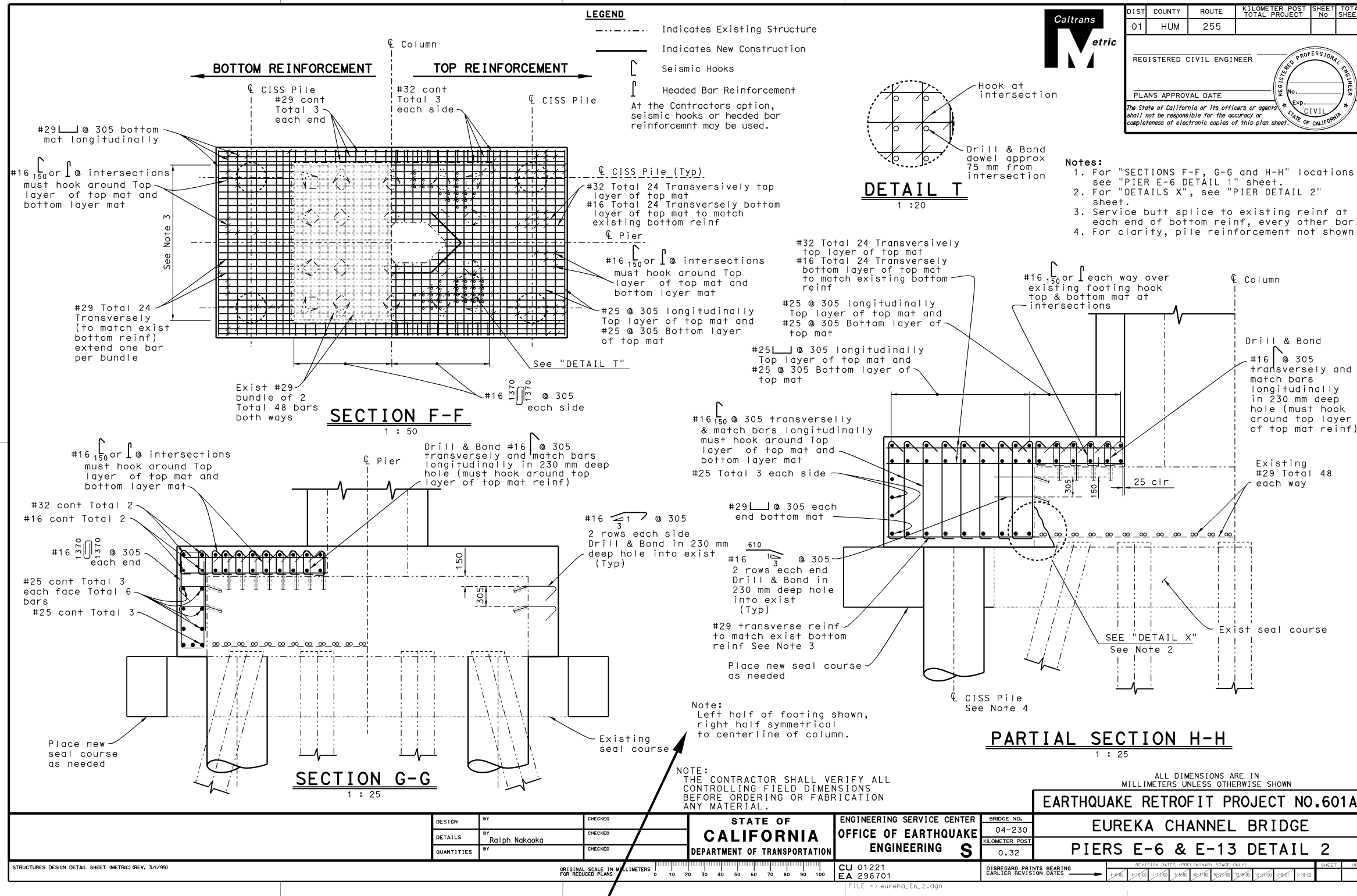
Note the "FOUNDATION PLAN" shown as BDD 18-4.2. These footing details provide the necessary dimensions for what is a very complex design. Take a moment to read the 'NOTES', and find this footing has been retrofitted on a previous project.



Note the “DOWEL LAYOUT” has a “LEGEND” that indicates the size and depth of the various dowels to be used, and with detailed location dimensions shown provides adequate information to calculate quantities. Read the ‘Notes’ 1 thru 6. Well-written notes provide additional information and highlight troublesome areas in ways that details may not. They may reduce the number of details while clarifying others.

The “CONCRETE REMOVAL/ECAVATION AND BACKFILL PAY LIMITS” is necessary due to the unusual shape of this footing and provides the information in one place.

This sheet shows a retrofitted footing/column combination. The column work is referenced but is detailed elsewhere. The column is shown with a ‘cut’ line that allows a reference dimension to be used. The chart “COULMN HEIGHT” contains the location specific values. This allows the similarity of the footing to override the dissimilarity of the column, thus this one sheet covers 2 bent locations. The “NOTES” describe the various sheets with supporting details.

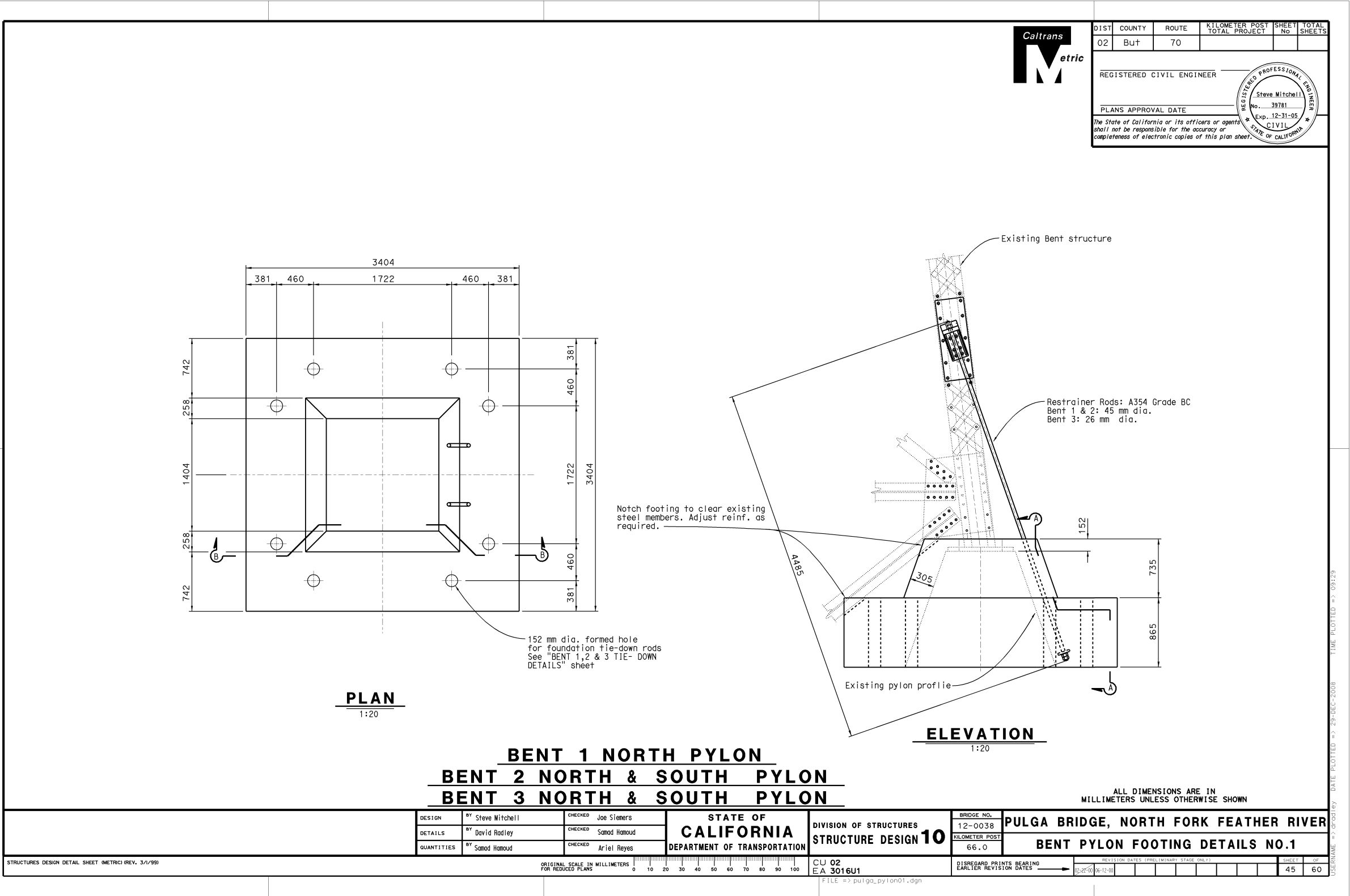


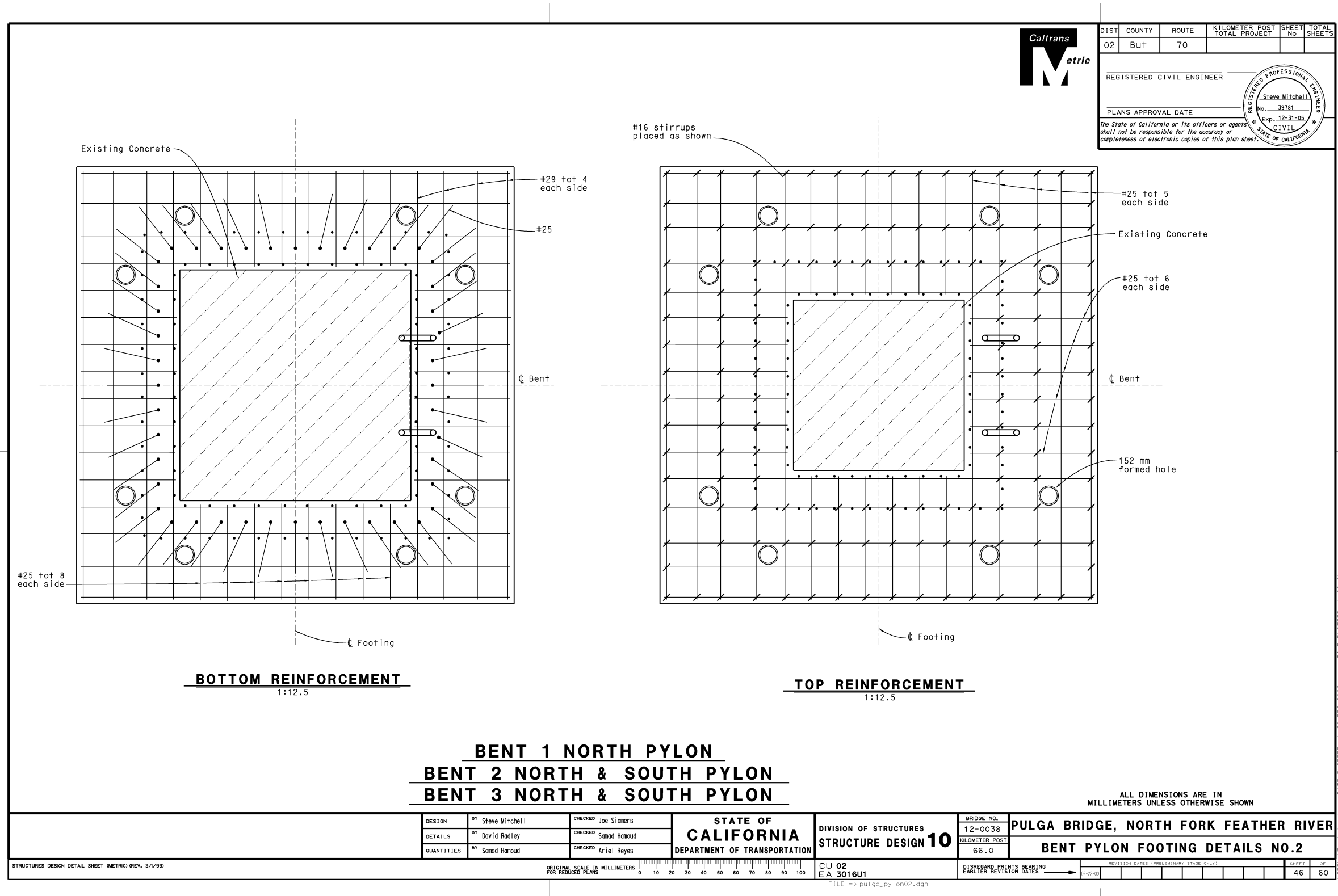
These details support the previous page shown as BDD 18-8.3. Note the “LEGEND” shows an option for hooks or headed bars.

Note “SECTION F-F”, uses a technique that allows the one detail to describe to 2 levels of reinforcement. This is used often on footing plans/sections.

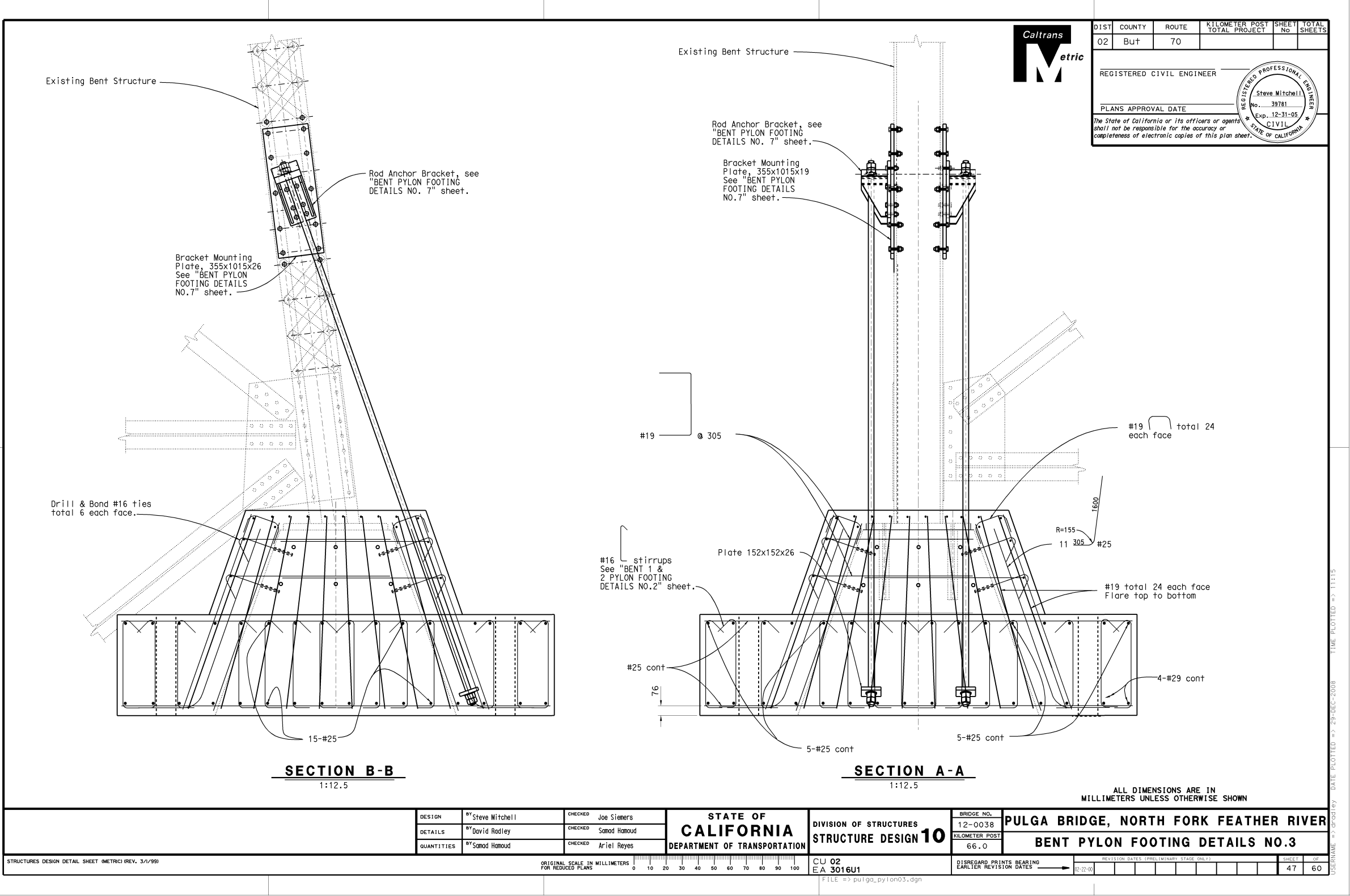
“PARTIAL SECTION H-H” uses the footings symmetry to an advantage in that only half of the footing need be detailed, citing the indicated note, the other half is assumed to be identical.

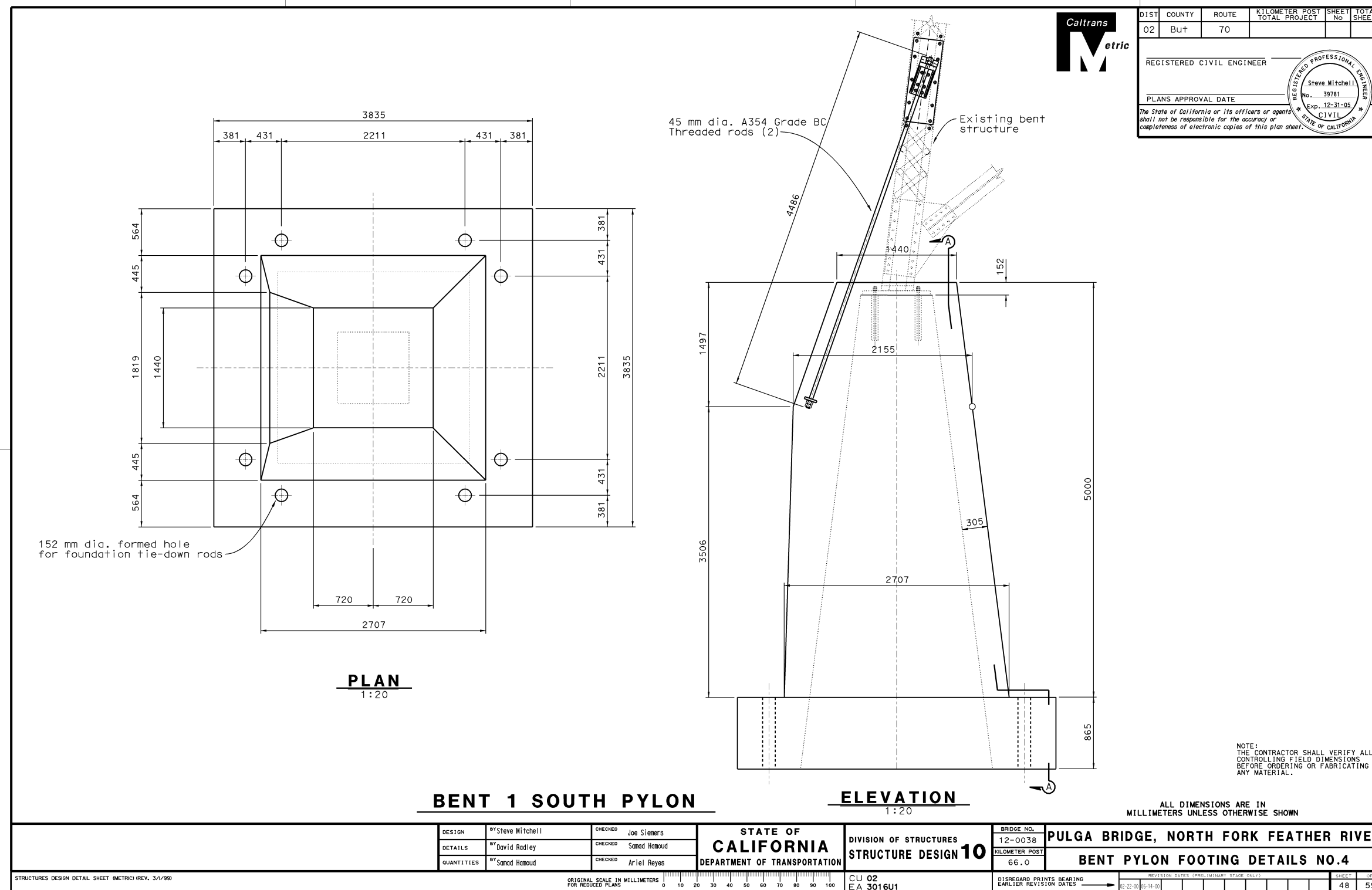
The first of five related examples, show a footing tie-down retrofit. The details for this design will involve reinforced concrete and structural steel. There are existing steel as-built base drawings that will need to be created. See “BDD SECTION 18 GUIDELINES FOR SEISMIC RETROFITS, 18.5.2 FOOTINGS.” And “BDD SECTION 18 GUIDELINES FOR SEISMIC RETROFITS, 18.8.0 RETROFIT HAREWARE AND FABRICATION.” SDT should determine early on the application of retrofit types on similar locations as this could affect the way the base details are produced. Where possible the use of rotating and/or mirroring of details should be considered.





This example uses concrete to encase the existing footing and provide locations for foundation tie-down rods.







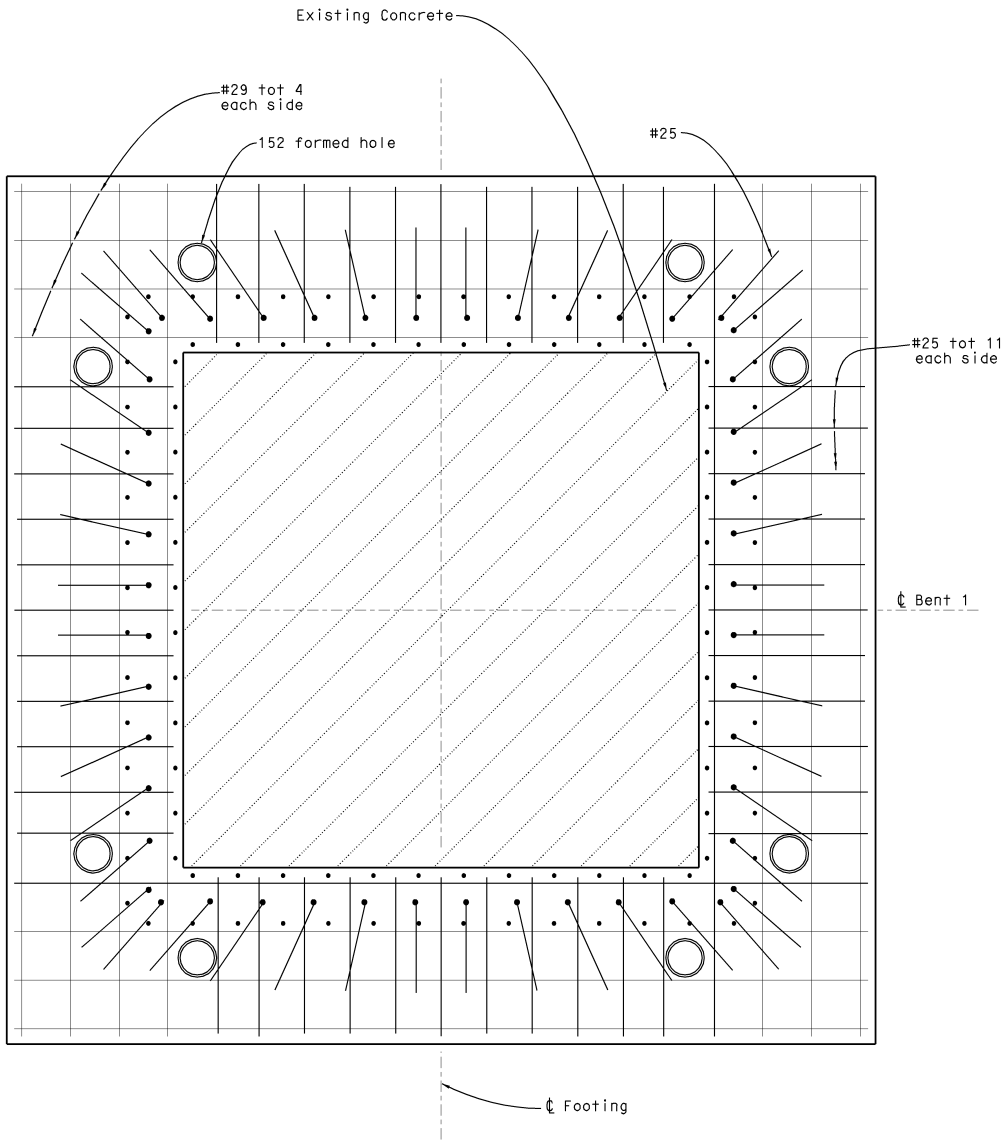
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REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

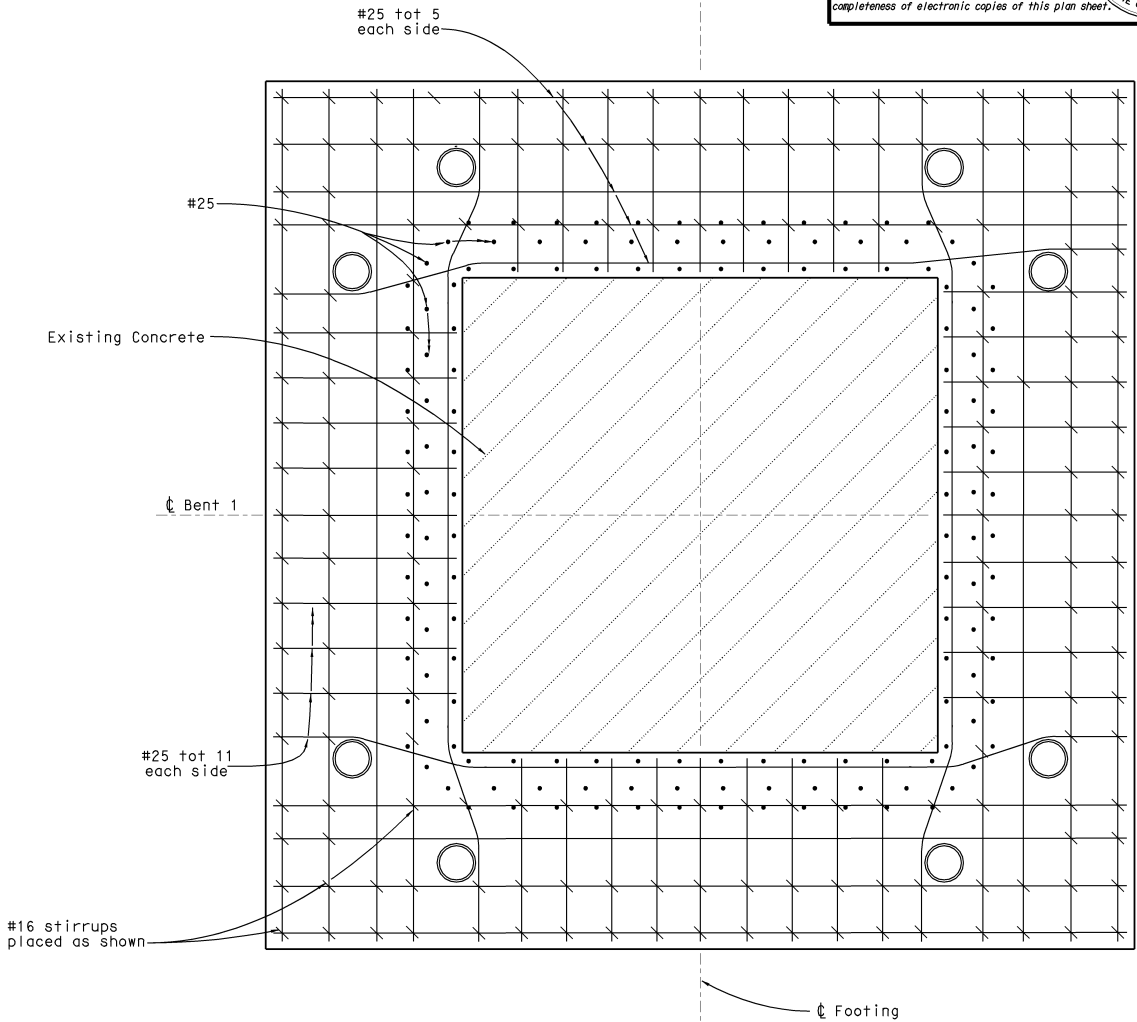
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

REGISTERED PROFESSIONAL ENGINEER
Steve Mitchell
No. 39781
Exp. 12-31-05
CIVIL
STATE OF CALIFORNIA



BOTTOM REINFORCEMENT
1:12.5

BENT 1 SOUTH PYLON



TOP REINFORCEMENT
1:12.5

NOTE:
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BEFORE ORDERING OR FABRICATING
ANY MATERIAL.

ALL DIMENSIONS ARE IN
MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	BY Steve Mitchell	CHECKED Joe Siemers	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF STRUCTURES STRUCTURE DESIGN 10	BRIDGE NO. 12-0038	PULGA BRIDGE, NORTH FORK FEATHER RIVER BENT PYLON FOOTING DETAILS NO.5
DETAILS	BY David Rodley	CHECKED Samad Hamoud			KILOMETER POST 66.0	
QUANTITIES	BY Samad Hamoud	CHECKED Ariel Reyes				

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV. 3/1/99)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS

CU 02
EA 3016U1

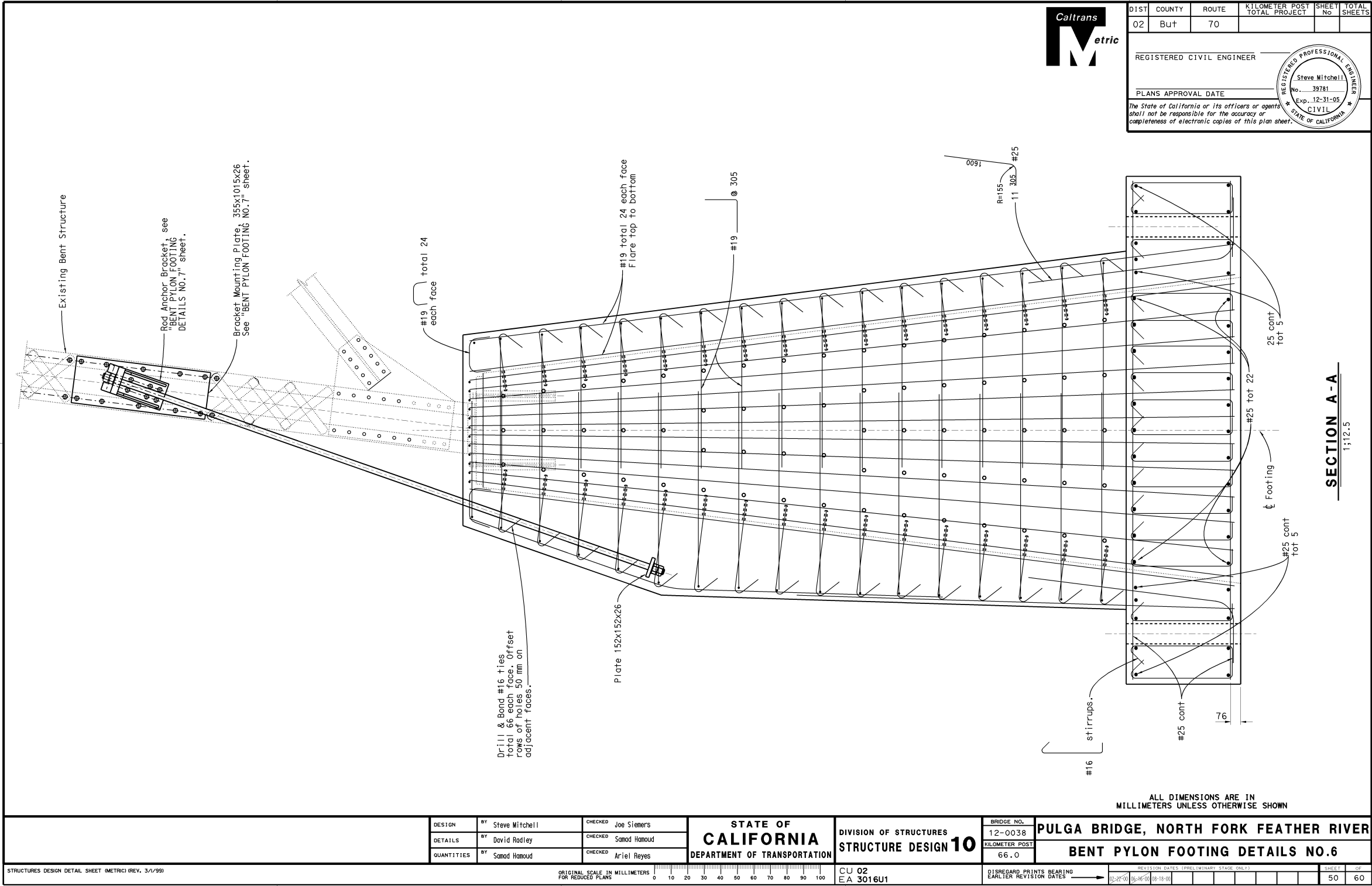
DISREGARD PRINTS BEARING
EARLIER REVISION DATES

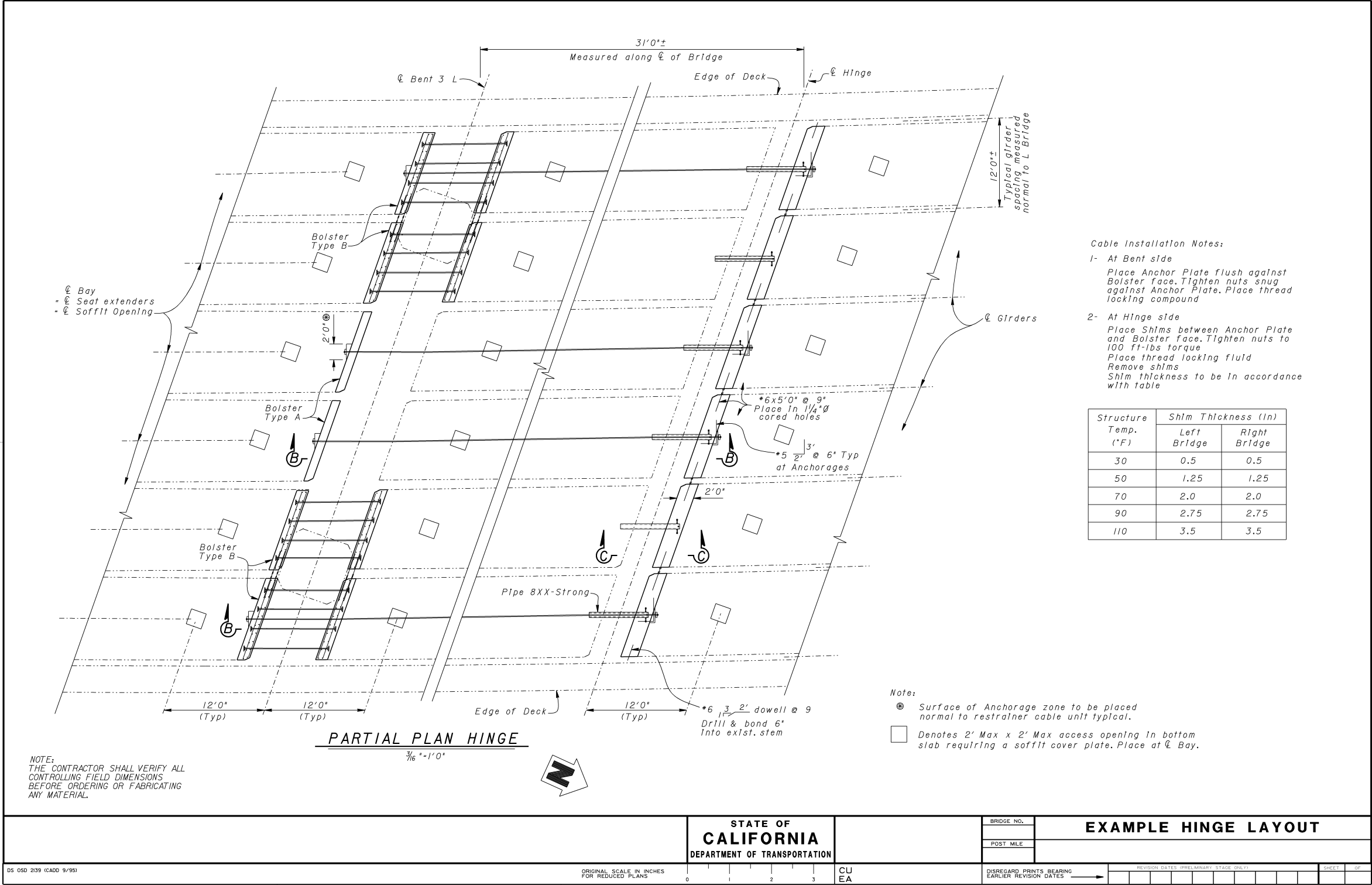
REVISION DATES (PRELIMINARY STAGE ONLY)

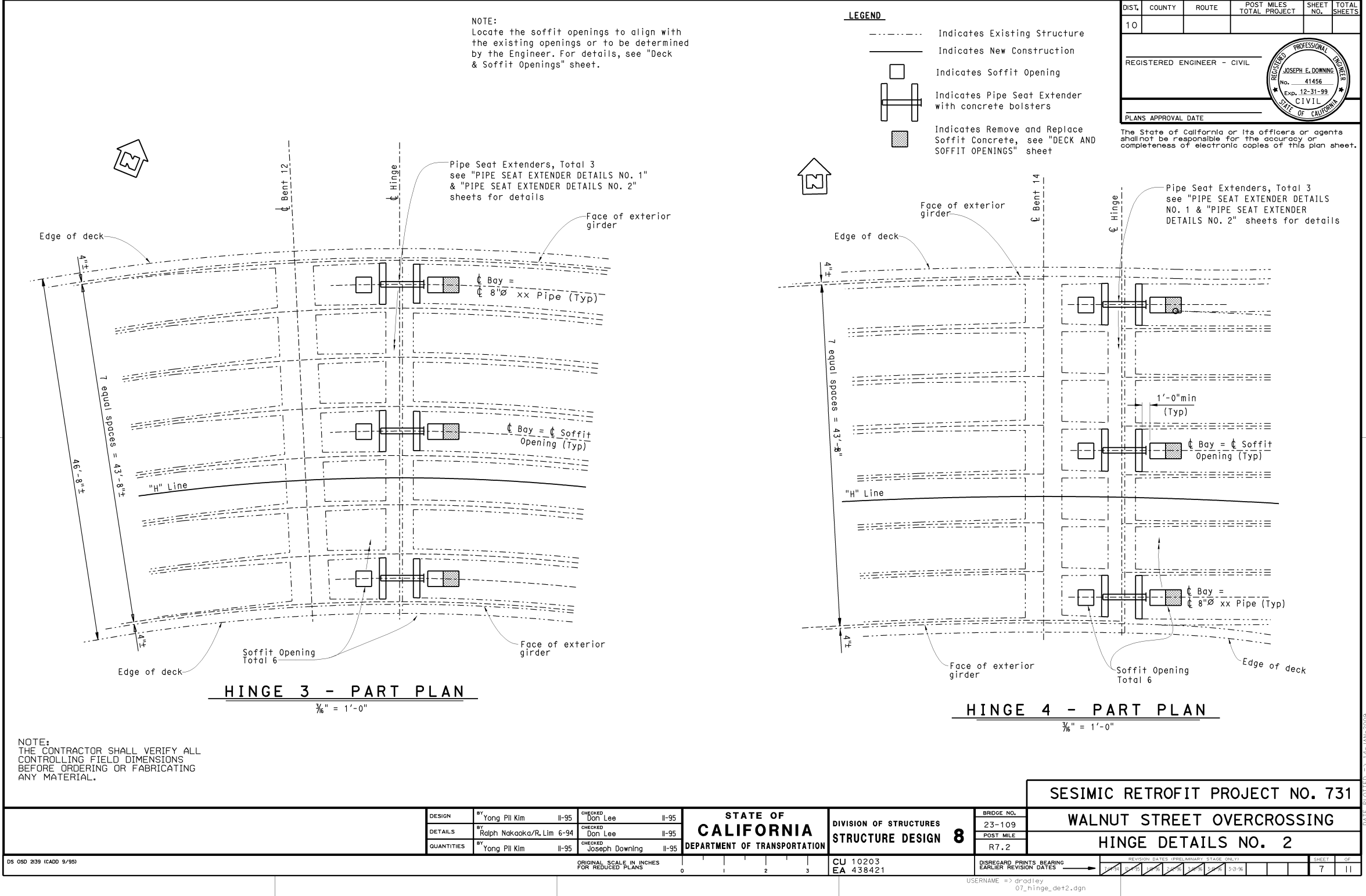
SHEET 49 OF 60

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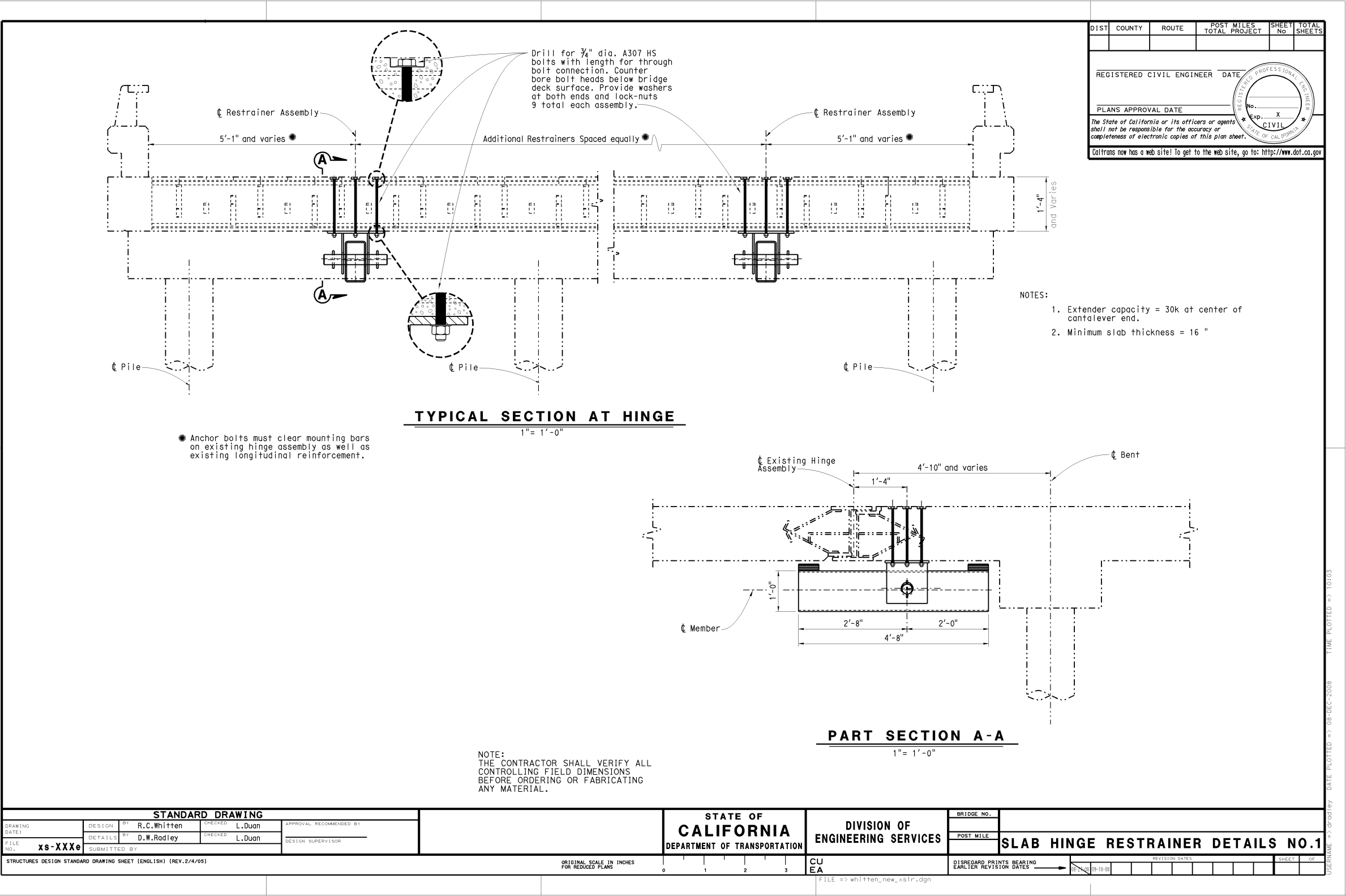
The rotation of details as shown here is not ideal. But this likely the only method that will yield the best end result. The bar shapes are clear and at a scale sufficient for quantities and constructability.

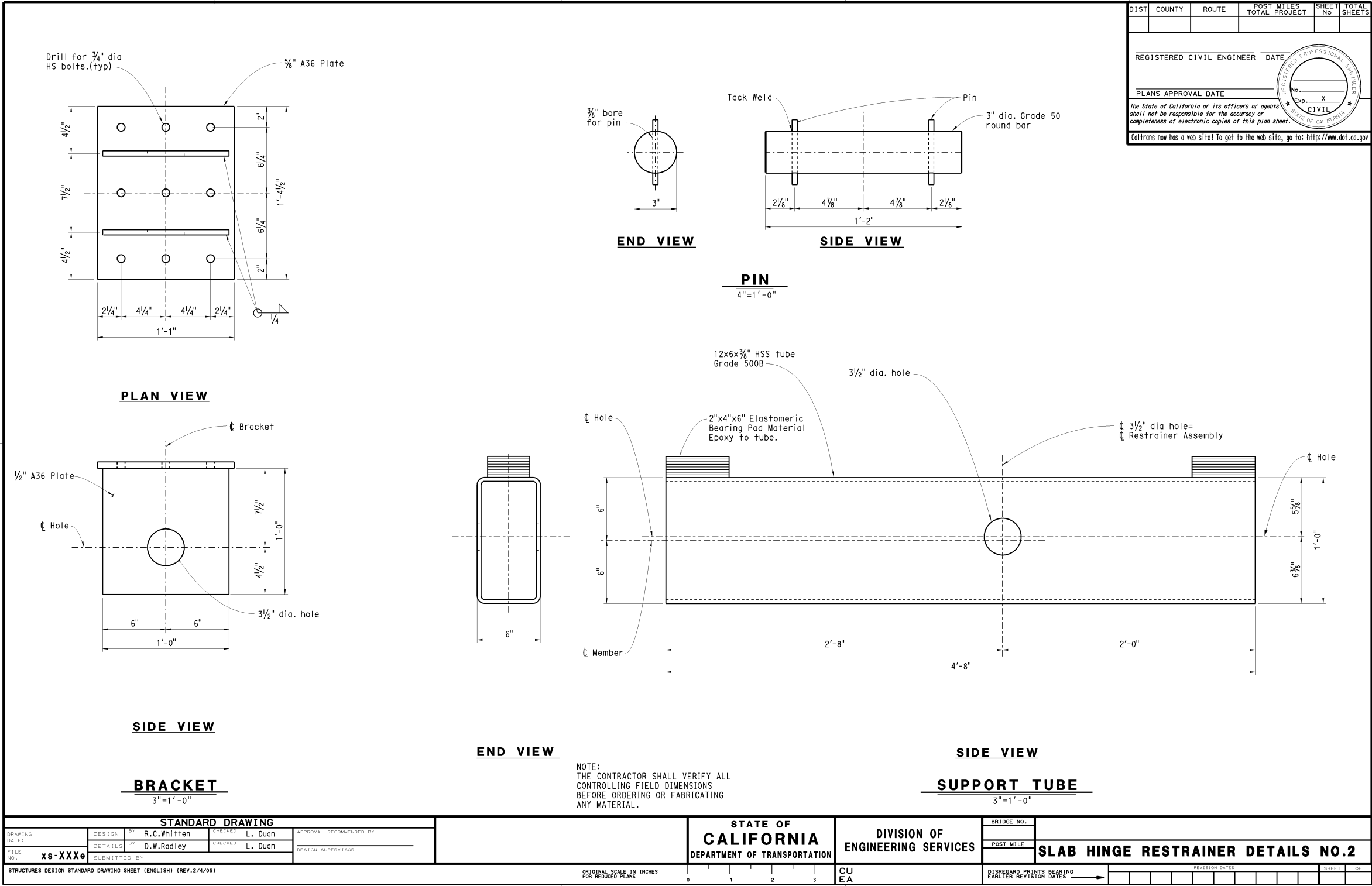


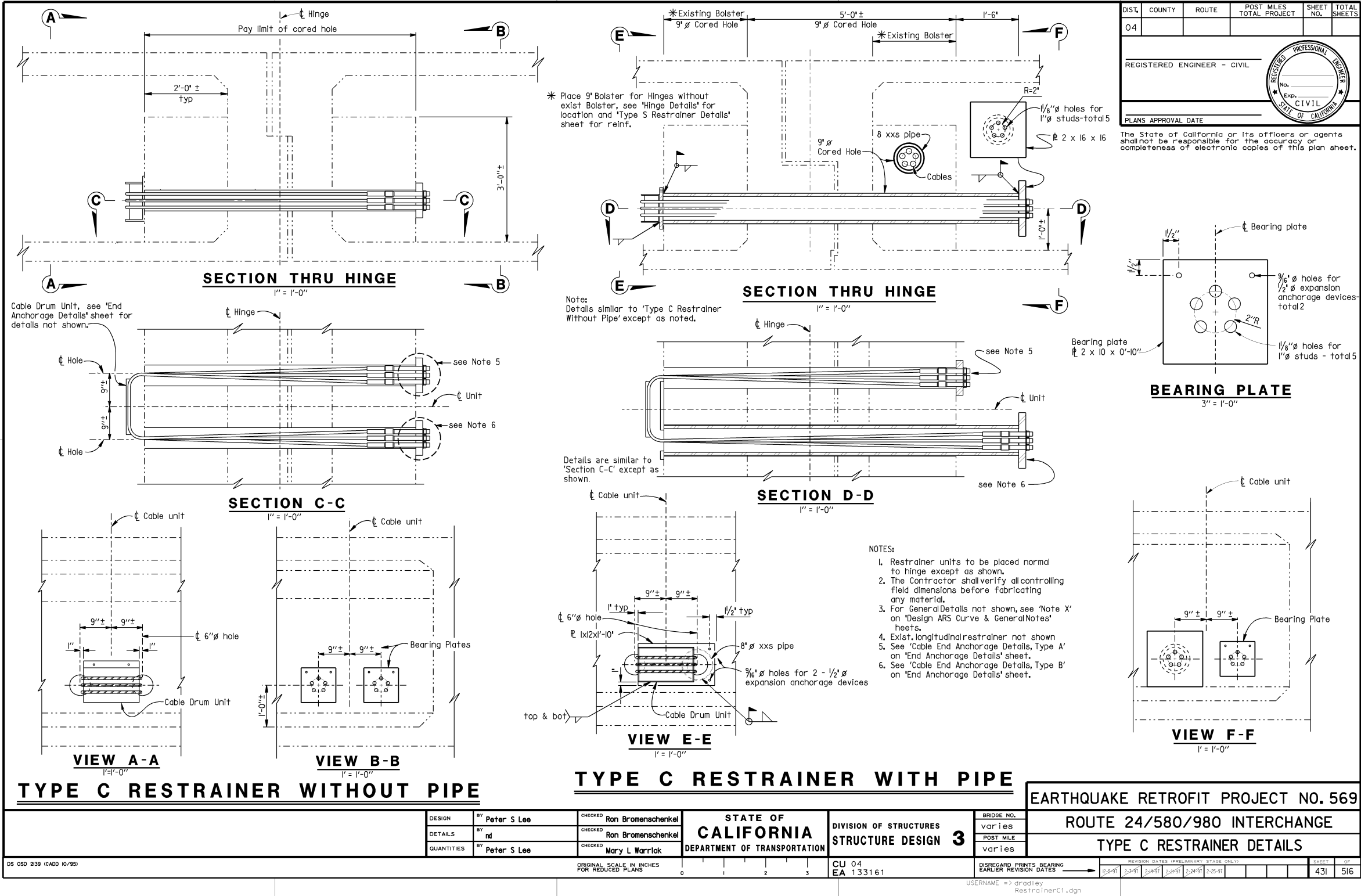


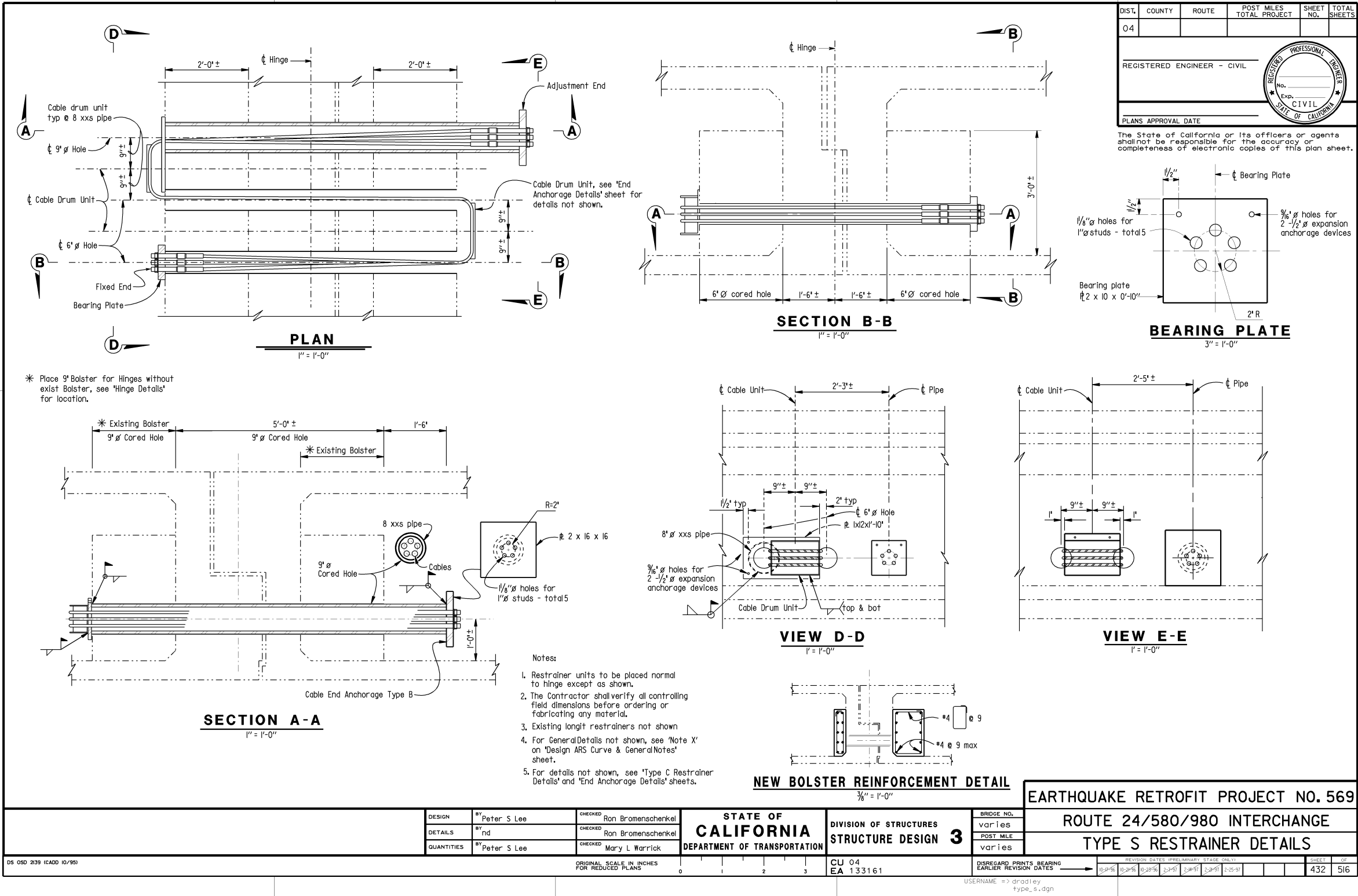


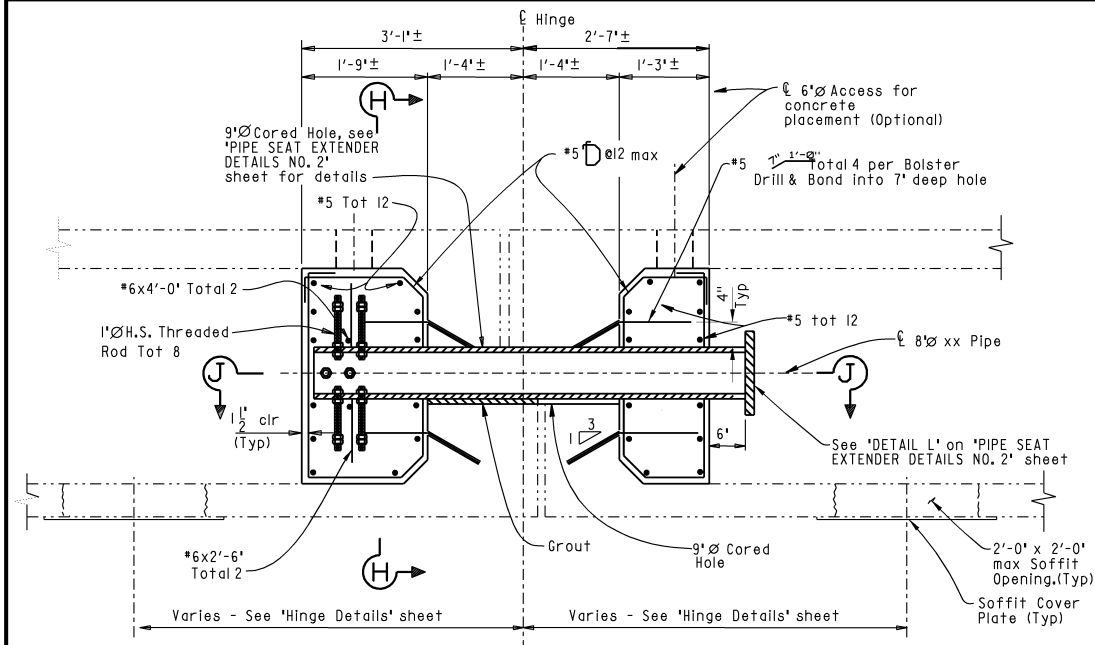
Note that the restrainer system shown here as fig 18-10.1 and the following page fig 18-10.2 are drawn in a Standard Plan border. At the time of publication of BDD 18 “SIESMIC RETRFITS AND STRENGTHENINGS” these pages had not been approved. They were included as examples in anticipation of xs status. Once approved, they will be relocated to the xs example group with any updates required.



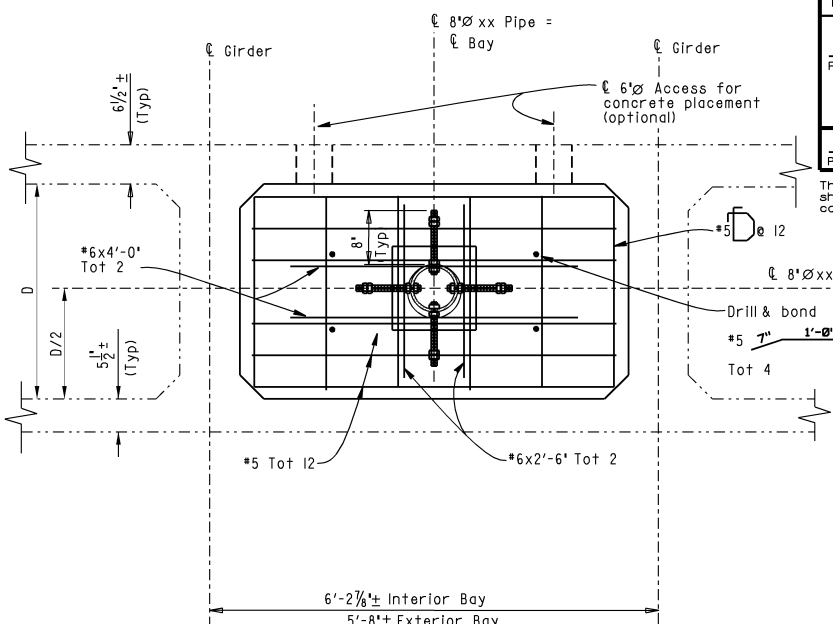






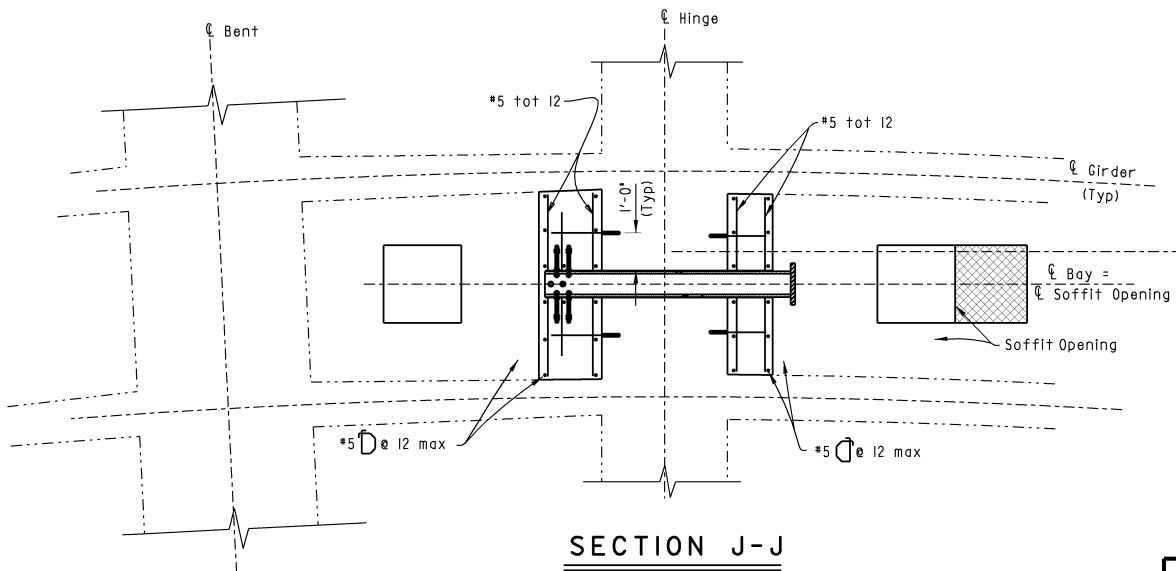


TYPICAL HINGE DETAIL
1" = 1'-0"



SECTION H-H
1" = 1'-0"

NOTES:
1. For pipe seat extender details, see 'DETAIL L' on 'PIPE SEAT EXTENDER DETAILS NO. 2' sheet.
2. For soffit opening details, see 'DECK AND SOFFIT OPENINGS' sheet.



SECTION J-J
1/2" = 1'-0"

LEGEND:
Indicates Remove and Replace Soffit Concrete, see 'DECK AND SOFFIT OPENINGS' sheet

NOTE:
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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
10					

REGISTERED ENGINEER - CIVIL

PLANS APPROVAL DATE

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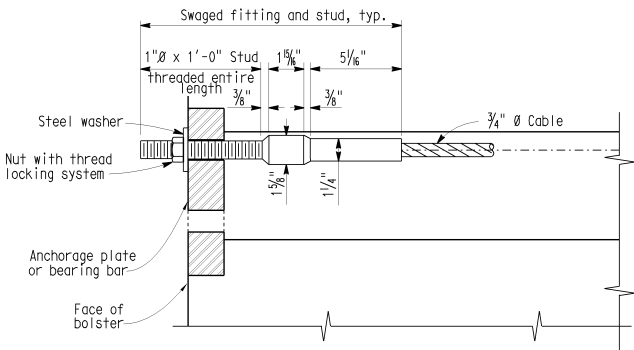
DESIGN	BY	DATE	CHECKED	DATE	STATE OF CALIFORNIA	DIVISION OF STRUCTURES	BRIDGE NO.	POST MILE	SEISMIC RETROFIT PROJECT NO. 731
DESIGN	Yong Pli Kim	11-95	Don Lee	11-95	STATE OF CALIFORNIA	DIVISION OF STRUCTURES	23-109	R7.2	WALNUT STREET OVERCROSSING
DETAILS	Ralph Nakaoka/R. Lim	10-94	Don Lee	11-95	DEPARTMENT OF TRANSPORTATION	STRUCTURE DESIGN 8			PIPE SEAT EXTENDER DETAILS NO. 1
QUANTITIES	Yong Pli Kim	11-95	Joseph Downing	11-95					

CU 10203
EA 438421

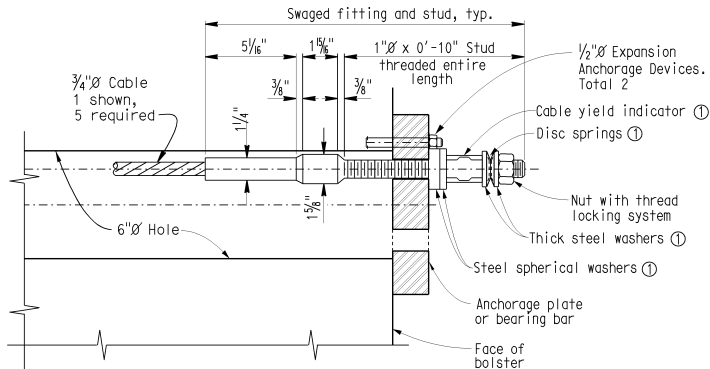
DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

DATE PLOTTED => 10-MAR-2009
TIME PLOTTED => 11:42

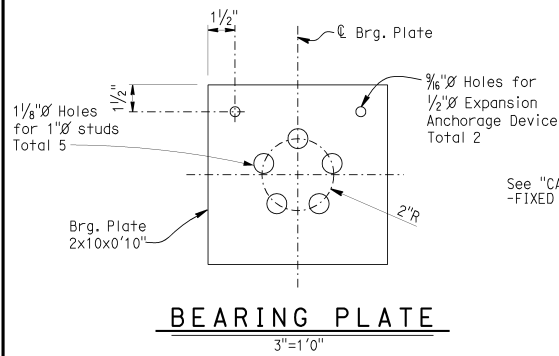


FIXED END
(TYPICAL BRACKET ANCHOR)
(Single-end adjustment restrainer units)

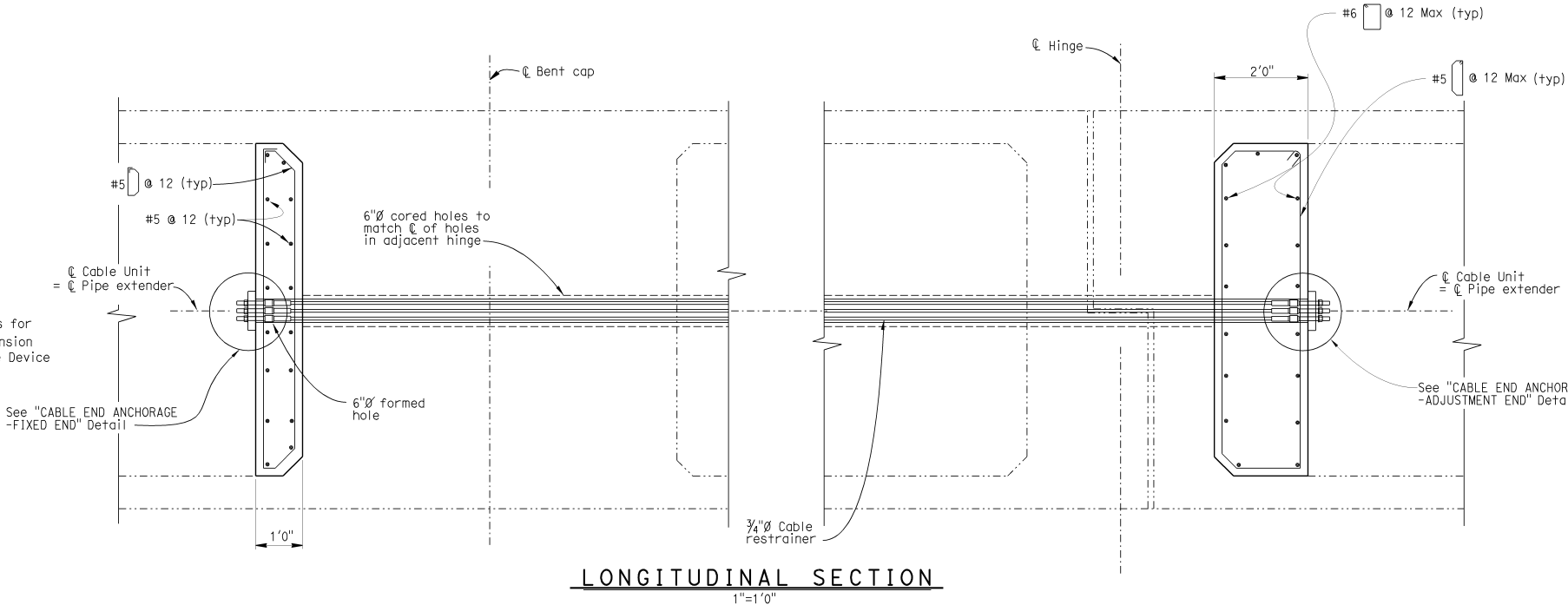


ADJUSTMENT END

CABLE END ANCHORAGE
3"=1'0"



BEARING PLATE
3"=1'0"



LONGITUDINAL SECTION
1"=1'0"

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
X	X	X			

REGISTERED CIVIL ENGINEER DATE X

PLANS APPROVAL DATE

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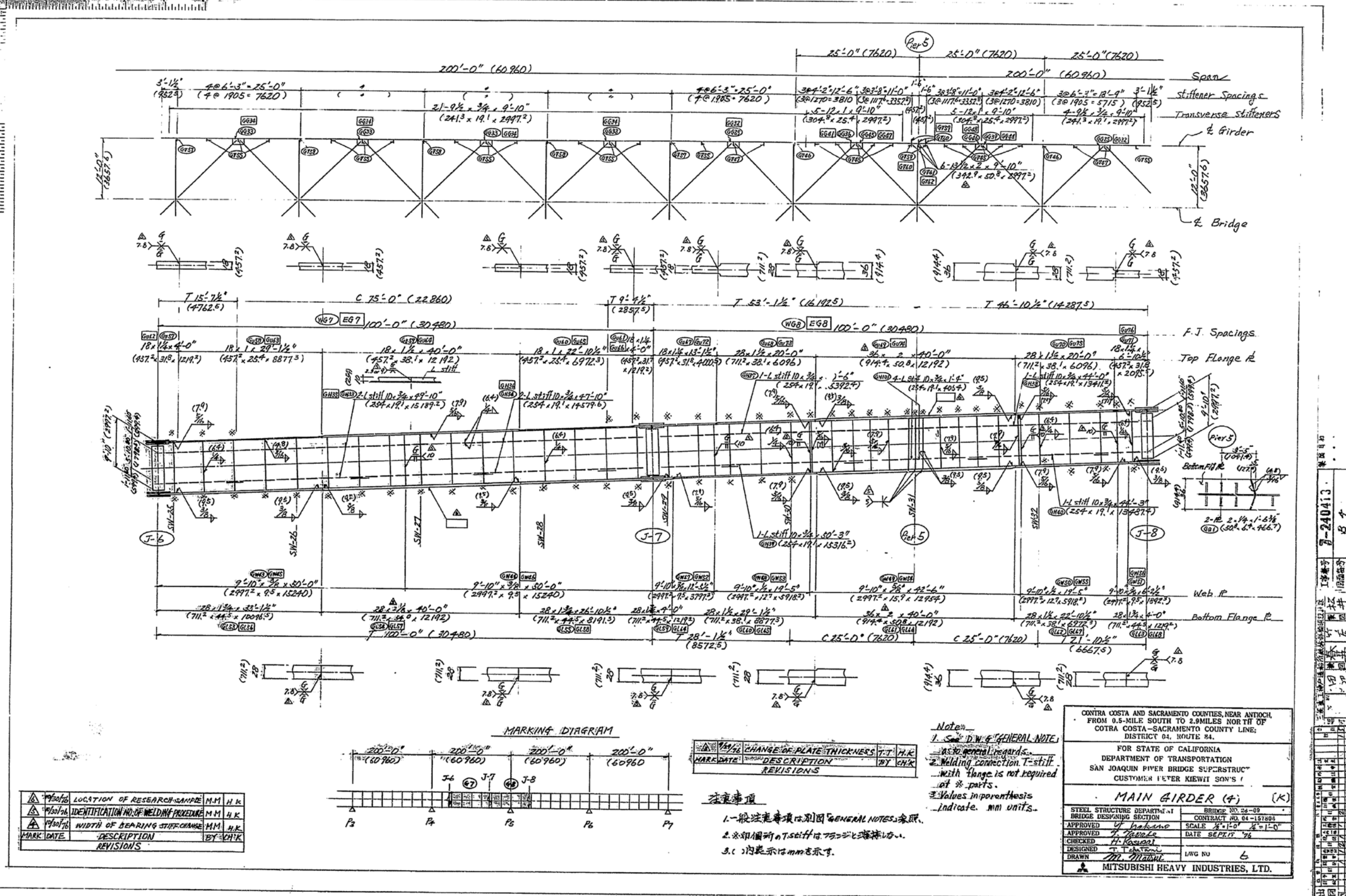
To get to the Caltrans web site, go to: <http://www.dot.ca.gov>

① For dimensions and installation procedure, see "RESTRAINER UNIT-ADJUSTMENT END DETAILS" sheet XS-T10e-2

STANDARD DRAWING				STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION		DIVISION OF ENGINEERING SERVICES		BRIDGE NO. X		X	
RELEASE DATE X/X/08	DESIGN BY X CHECKED X	APPROVAL BY X CHECKED X	APPROVAL RECOMMENDED BY X					POST MILE X		RESTRainer UNIT - MISCELLANEOUS DETAILS	
FILE NO. xs7-XXXe	SUBMITTED BY X		DESIGN SUPERVISOR X								
STRUCTURES DESIGN STANDARD DRAWING SHEET (ENGLISH) (REV. 10/25/05)				ORIGINAL SCALE IN INCHES FOR REDUCED PLANS		0 1 2 3		CU X EA X		DISREGARD PRINTS BEARING EARLIER REVISION DATES	
								REVISION DATES		SHEET X	
										OF X	

FILE => hinge_rest_d.dgn

TIME PLOTTED => 13:49
DATE PLOTTED => 03-DEC-2008
USERNAME => gradley



This is a shop plan sheet. You will find all dimensions and notes necessary to fabricate the girder shown. All welding symbols and supporting diagrams, plus inventory control data.

Note the readability of this page. This is a print of a BIRIS .pdf made from very high quality shop drawing. Most shop plans are not this clean. When the SDT becomes involved with project needing data from a highly obscured shop plan, consult with your SDT 3 for help.

AMERICAN WELDING SOCIETY

Typical Welding Symbols		
Double-Fillet Welding Symbol <p>Weld size $\frac{1}{4}$ Length 6 Pitch $\frac{1}{16}$</p> <p>Omission of length indicates that weld extends between abrupt changes in direction or as dimensioned</p>	Chain Intermittent Fillet Welding Symbol <p>Pitch (distance between centers) of increments $\frac{5}{16}$ Size (length of leg) $\frac{7}{16}$ Length of increments 2-5</p>	Staggered Intermittent Fillet Welding Symbol <p>Pitch (distance between centers) of increments $\frac{1}{2}$ Size (length of leg) $\frac{1}{2}$ Length of increments 3-5</p>
Plug Welding Symbol <p>Included angle of countersink 30° Size (diameter of hole at root) 1 Pitch $\frac{3}{4}$ Depth of filling in inches (omission indicates filling is complete) 4</p>	Back Welding Symbol <p>Back weld 2nd operation 1st operation</p>	Backing Welding Symbol <p>Backing weld 1st operation 2nd operation</p>
Spot Welding Symbol <p>Size or strength RSW 025 Number of welds (5) Pitch 4 Process RSW</p>	Stud Welding Symbol <p>Size $\frac{1}{2}$ Pitch 6 Number of studs (7)</p>	Seam Welding Symbol <p>Size or strength RSEW 030 Increment length 3-9 Pitch 3-9 Process RSEW</p>
Square-Groove Welding Symbol <p>Weld size $\frac{3}{16}$ Root opening $\frac{1}{2}$ Root opening $\frac{1}{2}$</p>	Single-V Groove Welding Symbol <p>Depth of bevel $\frac{1}{2}$ Weld size $\frac{1}{2}$ Root opening $\frac{1}{8}$ Groove angle 60° Groove angle 60°</p>	Double-Bevel-Groove Welding Symbol <p>Weld size (1) Weld size (1-1/4) Arrow points toward member to be prepared</p>
Symbol with Backgouging <p>Depth of bevel $\frac{3}{8}$ Back gouge</p>	Flare-V-Groove Welding Symbol <p>Weld size $\frac{1}{4}$</p>	Flare-Bevel-Groove Welding Symbol <p>Weld size $\frac{1}{4}$</p>
Multiple Reference Lines <p>1st operation on line nearest arrow 2nd operation 3rd operation</p>	Complete Penetration <p>Indicates complete joint penetration regardless of type of weld or joint preparation CJP</p>	Edge Flange Welding Symbol <p>Radius $\frac{3}{64} + \frac{1}{16}$ Weld size $\frac{1}{16}$ Height above point of tangency</p>
Flash or Upset Welding Symbol <p>Process reference FW</p>	Melt-Thru Symbol <p>Root reinforcement $\frac{1}{32}$</p>	Joint with Backing <p>'R' Indicates backing removed after welding</p>
Joint with Spacer <p>Double bevel groove</p>	Flush Contour Symbol <p>Flush contour</p>	Convex Contour Symbol <p>Convex contour (G)</p>

* It should be understood that these charts are intended only as shop aids. The only complete and official presentation of the standard welding symbols is in A2.4.

AMERICAN WELDING SOCIETY

Basic Welding Symbols and Their Location Significance

Location Significance	Fillet	Plug or Slot	Spot or Projection	Stud	Seam	Back or Backing	Surfacing	Flange Corner	Flange Edge
Arrow Side									
Other Side				Not Used			Not Used		
Both Sides		Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
No Arrow Side or Other Side Significance	Not Used	Not Used		Not Used		Not Used	Not Used	Not Used	Not Used
Location Significance	Groove							Scarf for Brazed Joint	
	SQUARE	V	Bevel	U	J	Flare-V	Flare-Bevel		
Arrow Side									
Other Side									
Both Sides									
No Arrow Side or Other Side Significance		Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	

Supplementary Symbols

Weld-All Around	Field Weld	Melt-Thru	Consumable Insert	Backing Spacer	Contour		
					Flush	Convex	Concave

Basic Joints

Identification of Arrow Side and Other Side Joint

Butt Joint	Corner Joint
T-Joint	Lap Joint
Edge Joint	Process Abbreviations

Location of Elements of a Welding Symbol

Finish symbol

Contour symbol

Groove weld size

Depth of bevel, size or strength for certain welds

Specification, process, or other reference

Tail (omitted when reference is not used)

Weld symbol

Elements in this area remain as shown when tail and arrow are reversed

Groove angle: included angle of countersink for plug welds

Root opening: depth of filling for plug and slot welds

Length of weld

Pitch (center-to-center spacing) of welds

Field weld symbol

Weld-all-around symbol

Arrow connecting reference line to arrow side member of joint or arrow side of joint

Reference line

Number of spot, seam, stud, plug, slot, or projection welds

Both Sides

Arrow Side

Other Side

Other Side

Arrow Side

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Arrow Side

Other Side

Both Sides

Arrow Side

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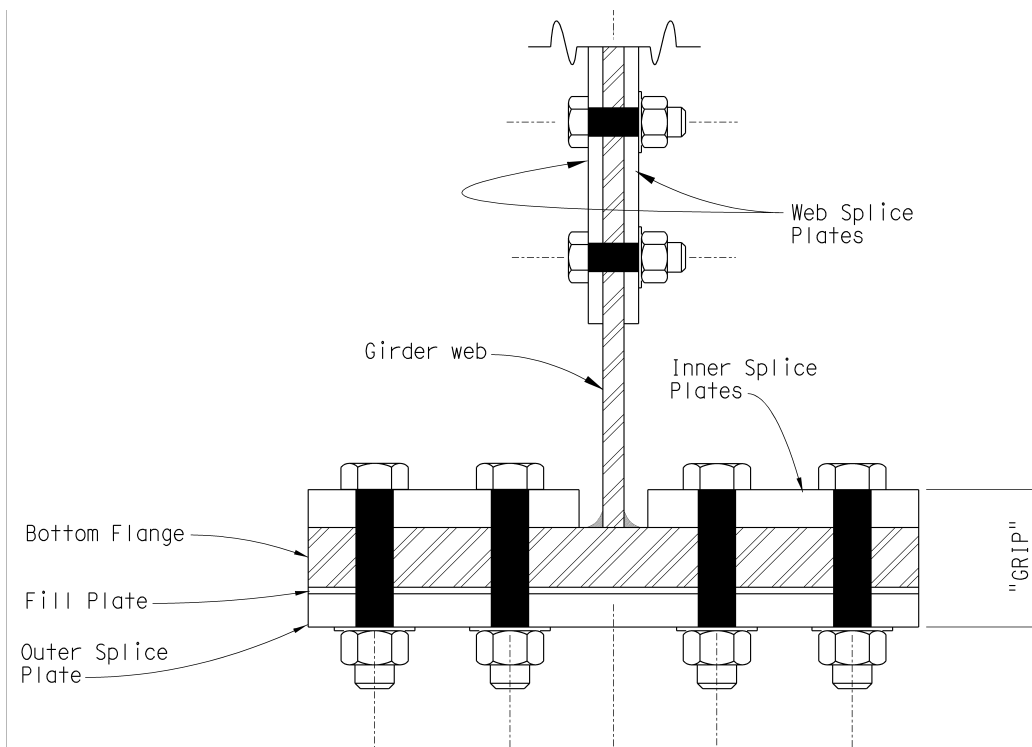
Both Sides

Arrow Side

Other Side

Both Sides

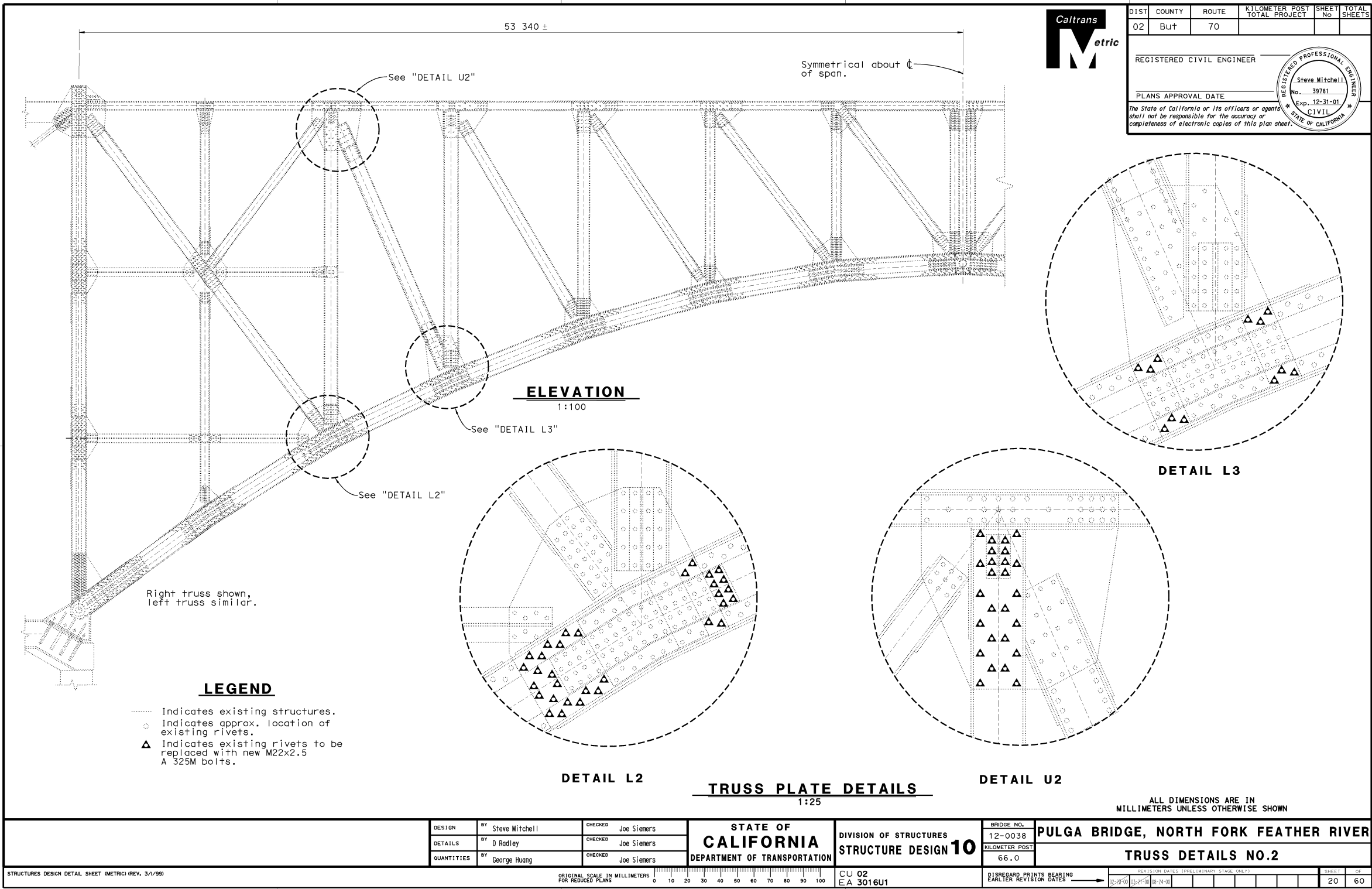
Arrow Side



Example Figure 18-11.4

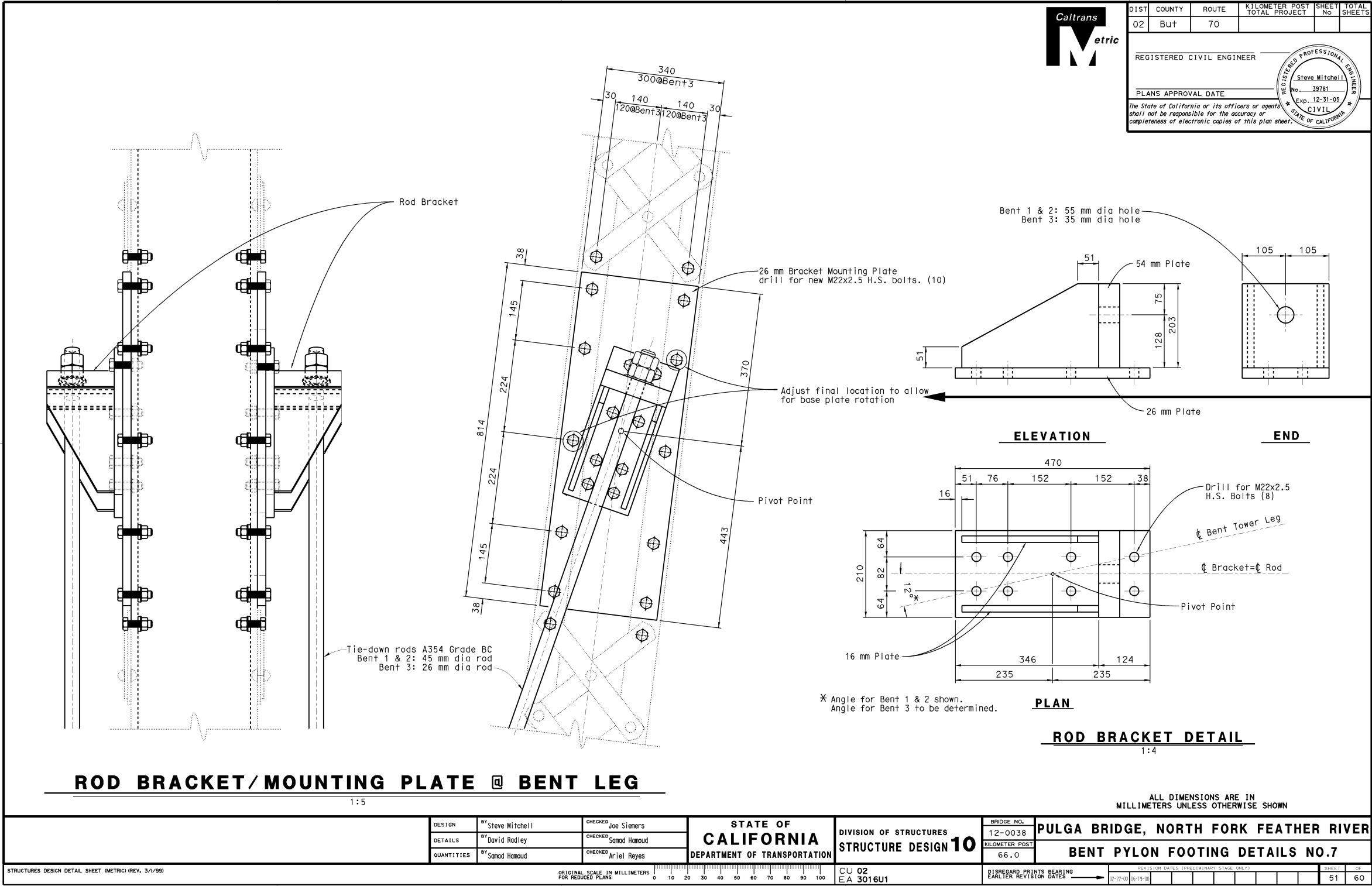
Note the illustration above. The dimension line on the right refers to the “*total thickness of all connected material, exclusive of washers*” (AISC “Manual of Steel Construction”) as the “grip”. The technique of using a solid black filled shape for the body of the bolts shown allows the grip to be easily described. The grip dimension is a quantity item that must be gathered for each bolt length. The engineer should provide information on diameter, washers etc. There are considerations for length: bolts 5” and less are available in ¼” increments and above 5”, ½” increments. Also, thread length is another variable to be noted. The Structural Design Technician should have a basic understanding of the illustration of bolted connections as they apply to steel/retrofit detailing. If layout dimensions are needed, the AISC “Manual of Steel Construction” Section 8 pages 8 thru 25 will be of interest.

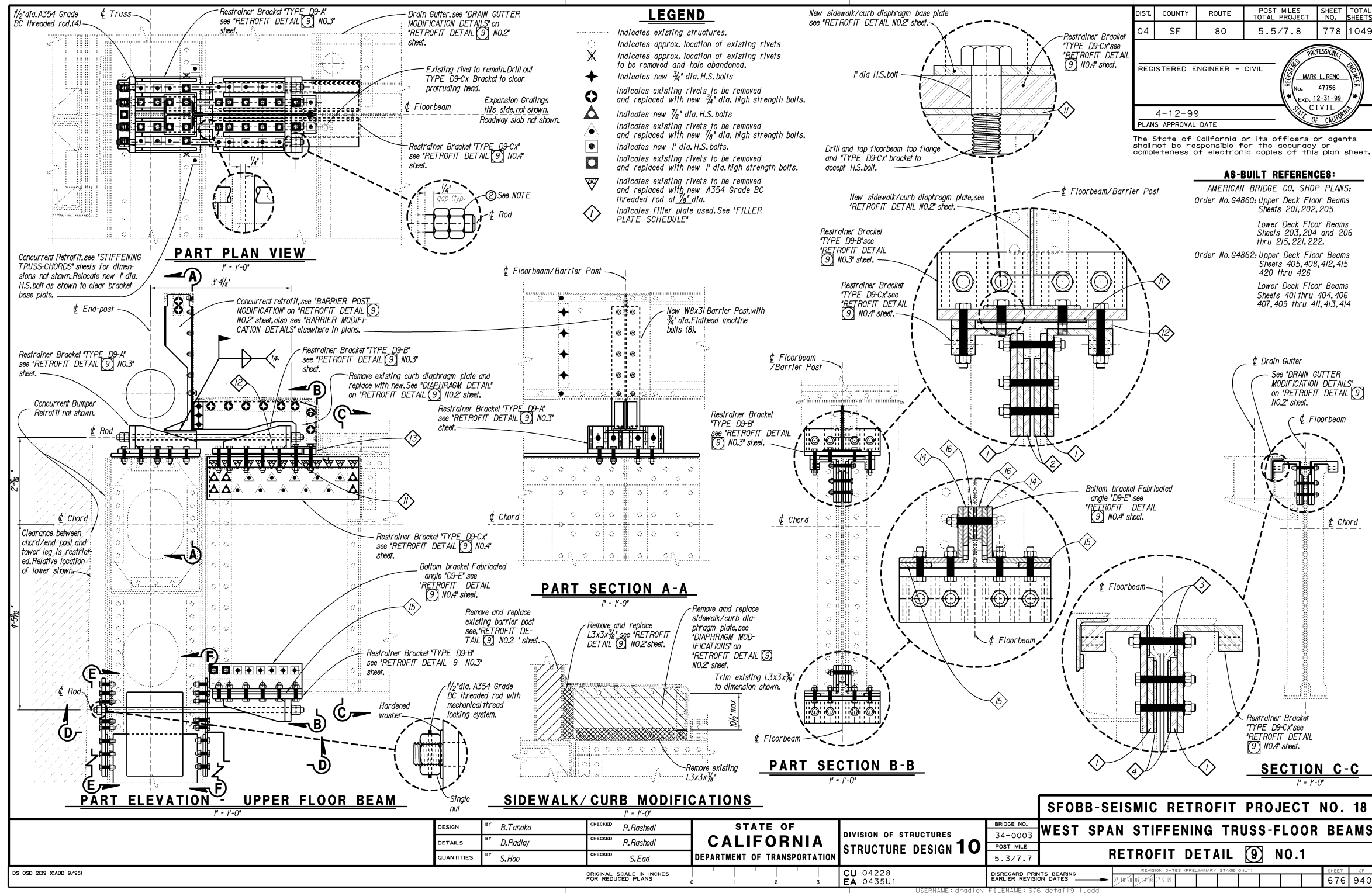
Microstation has fasteners detailed in the cell library “steel”. Remember, it may not be necessary to show repetitious patterns of fully detailed bolt heads or nuts if a hole or a drill-point symbol will suffice.

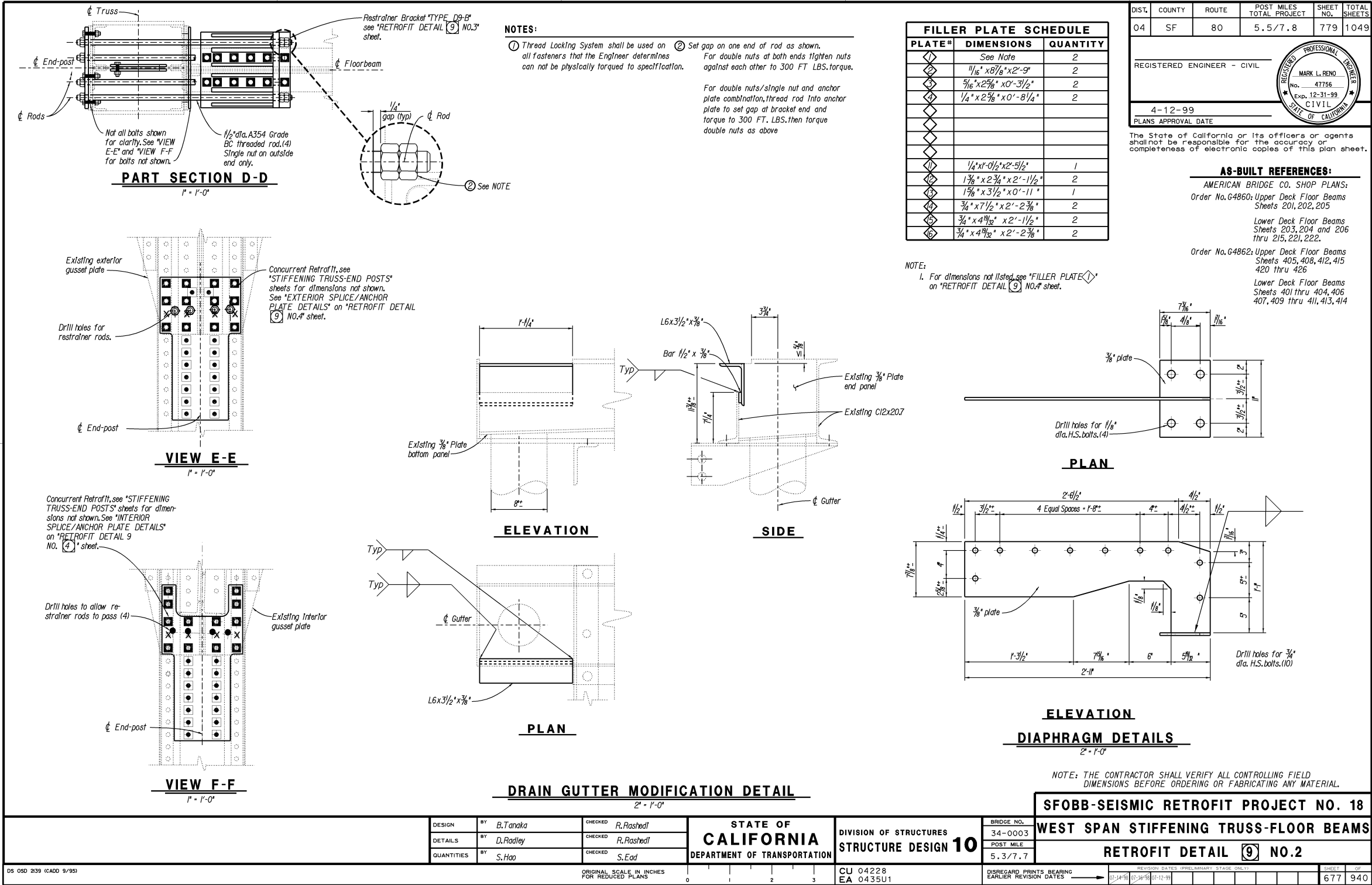


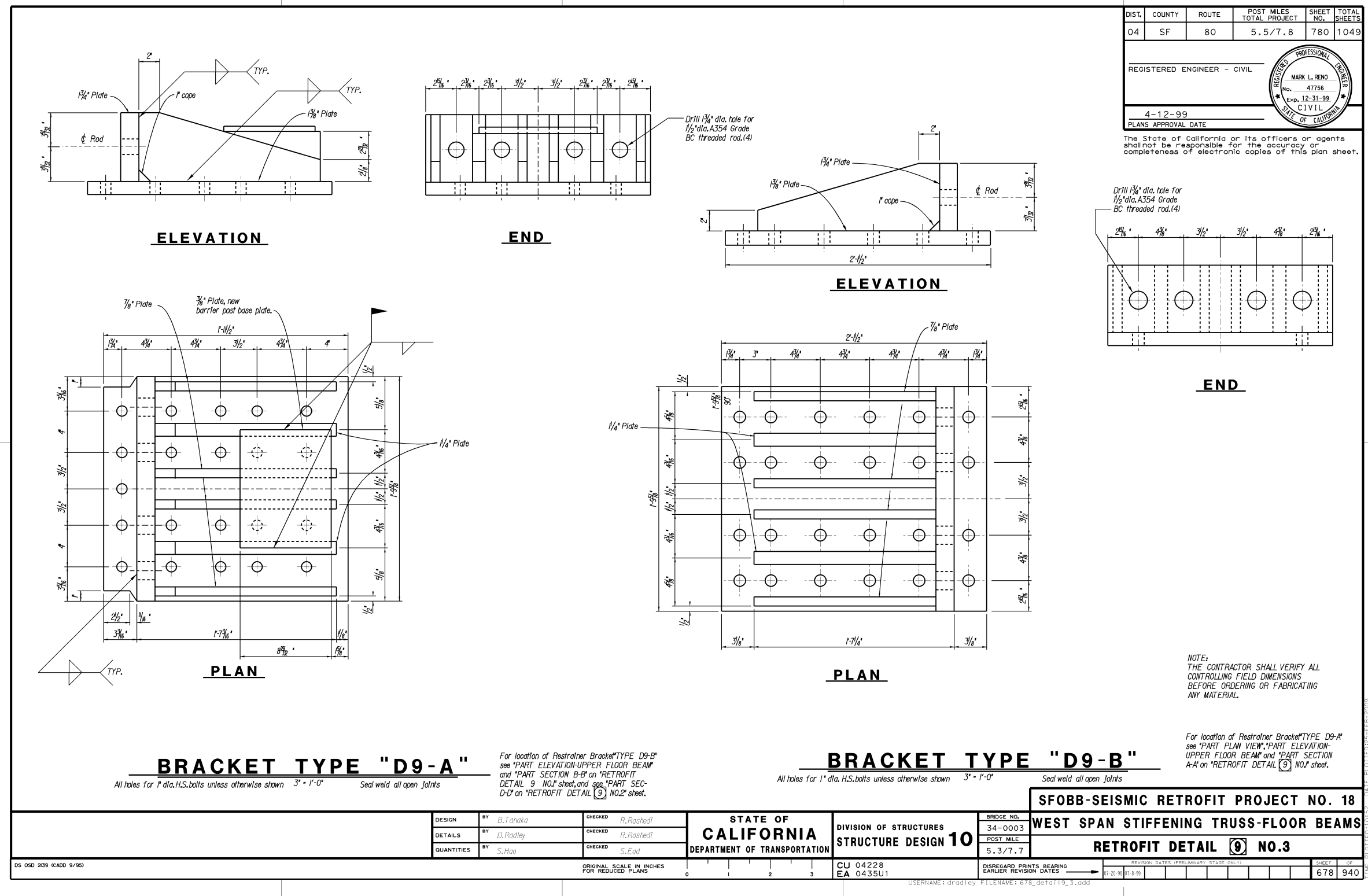
This sheet reflects a concept of replacing selected rivets with High Strength Bolts, a retrofit strategy that works for both Seismic and Strengthening applications. Note the 'LEGEND' indicates symbols for each size of new bolt required (only one in this instance). See BDD Sec.1 for guidelines on using 'dropout' line work. The time for development of this as-built base detail would seem considerable, but when you see the "Symmetrical About Centerline of Span" and the "Right Truss Shown Left Truss Similar" notes the time savings by rotating and/or mirroring the details become significant. Also, extracting the blow-ups of the connection details is quick and simple.

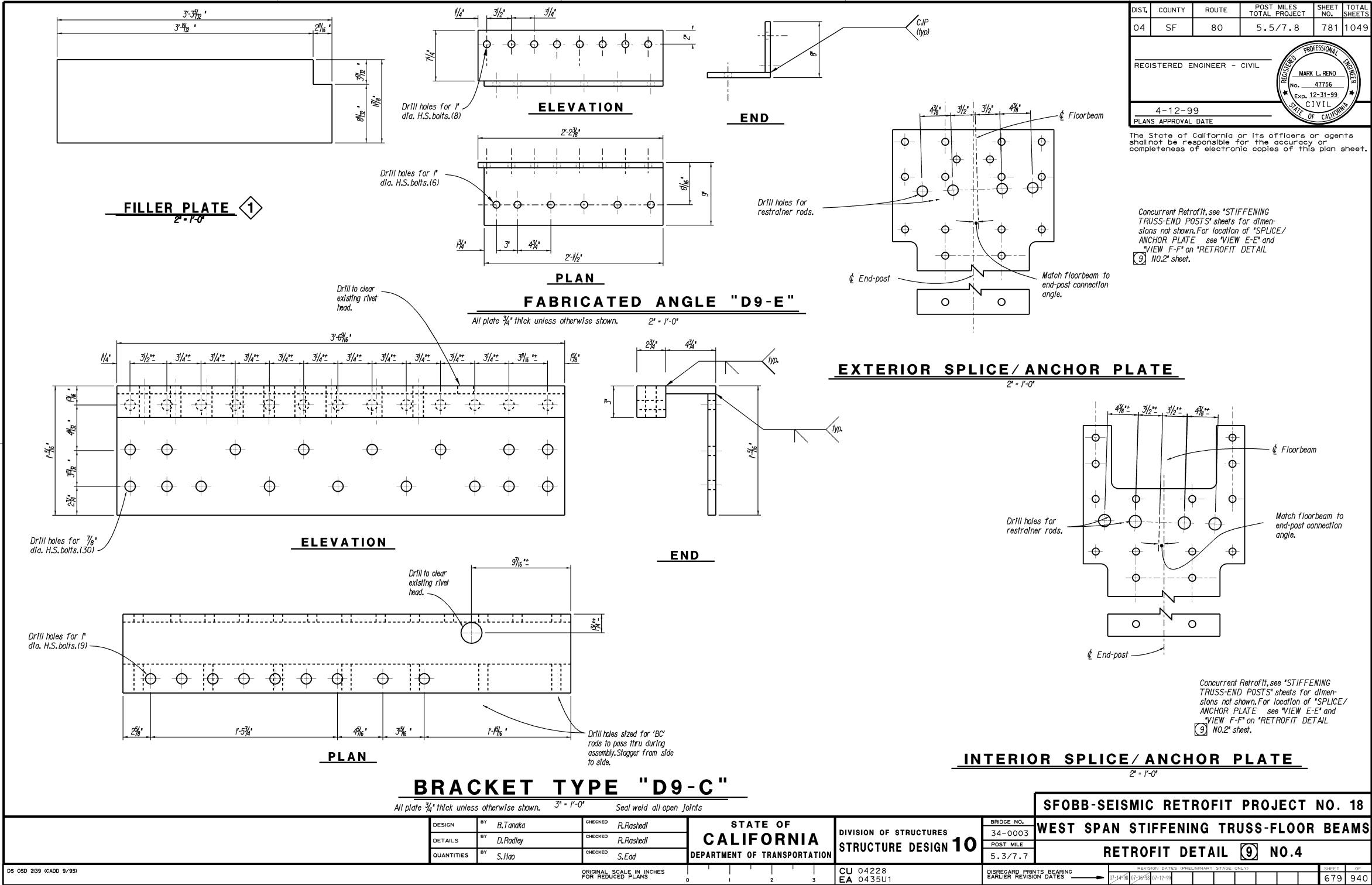
Note this example is the final detail sheet in 7-sheet sequence, see BDD 18-8.5 thru 18-8.10. The ‘ROD BRACKET DETAIL’ has all the dimensions required to produce a ‘Shop Plan’ that Caltrans will receive from the fabricator. The designer will compare our details with the shop plan for accuracy, and return them as “Approved” or reject them if he/she finds errors that must be corrected.

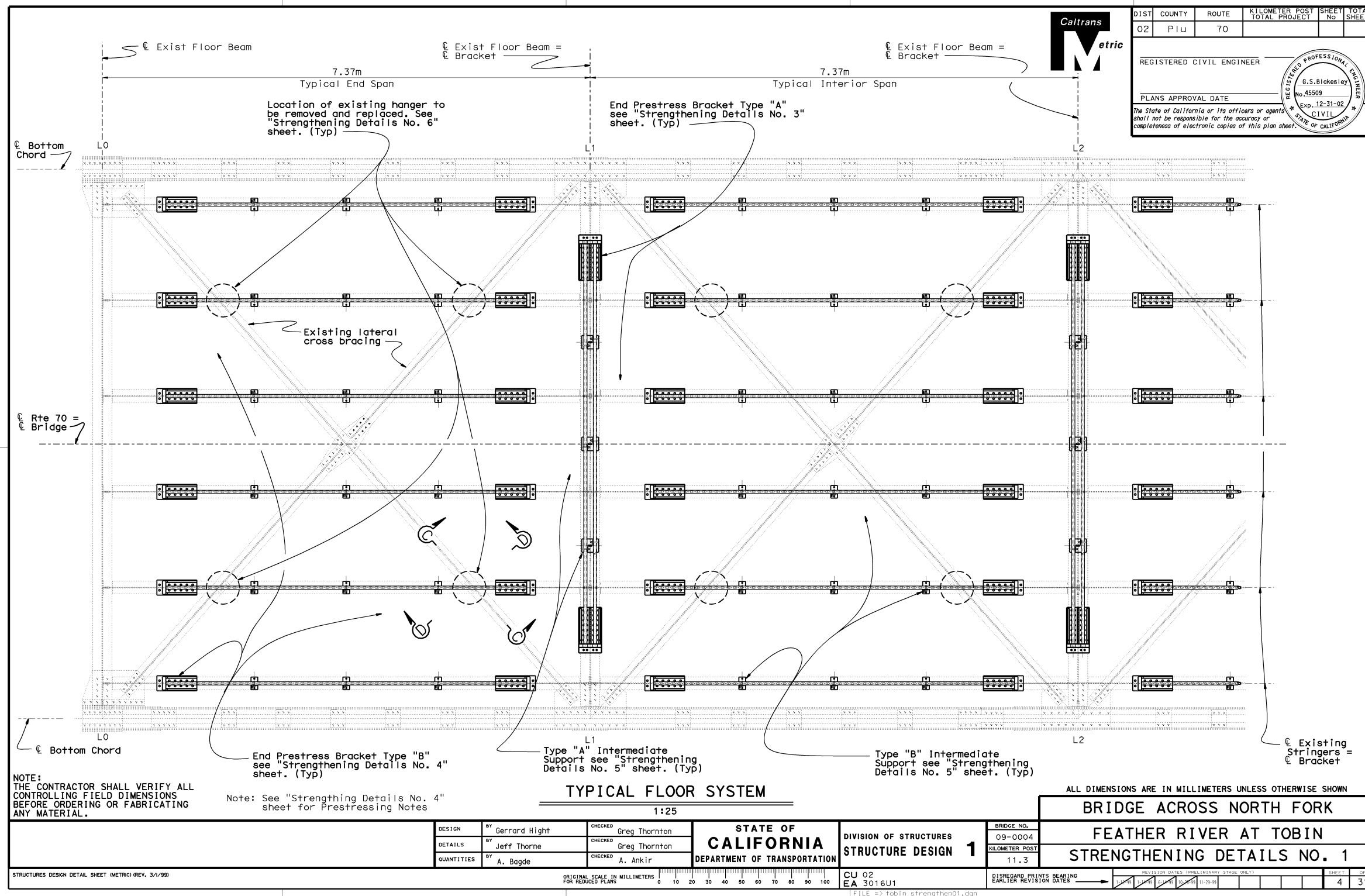














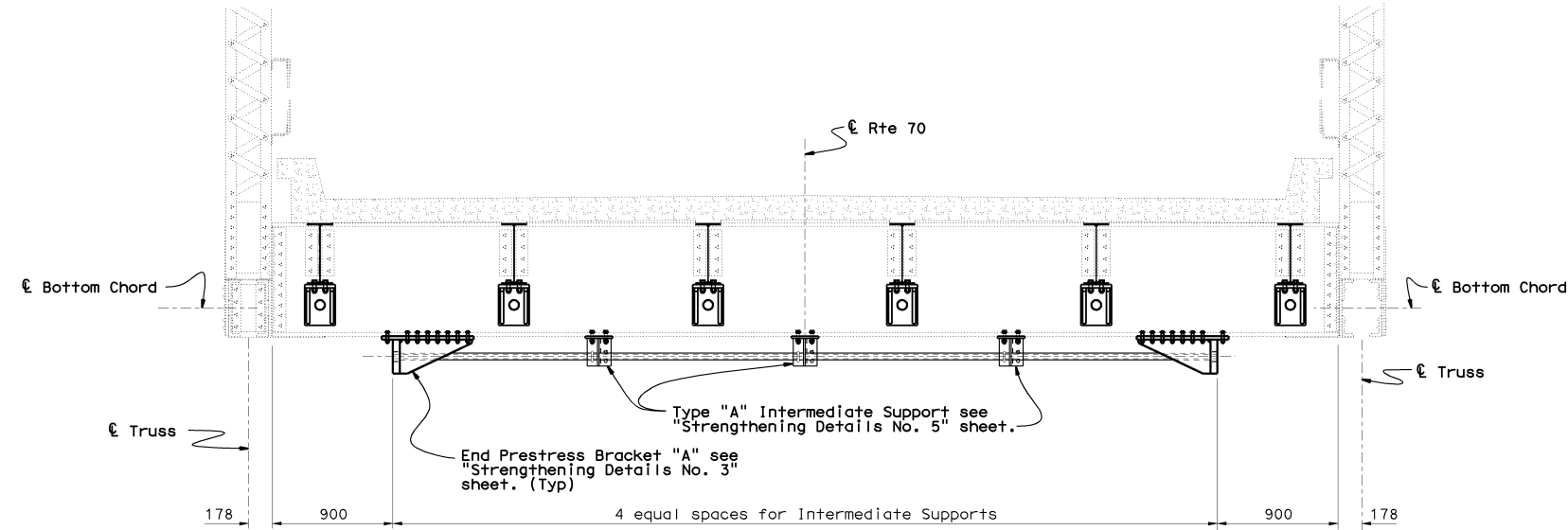
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
02	Plu	70			

REGISTERED CIVIL ENGINEER

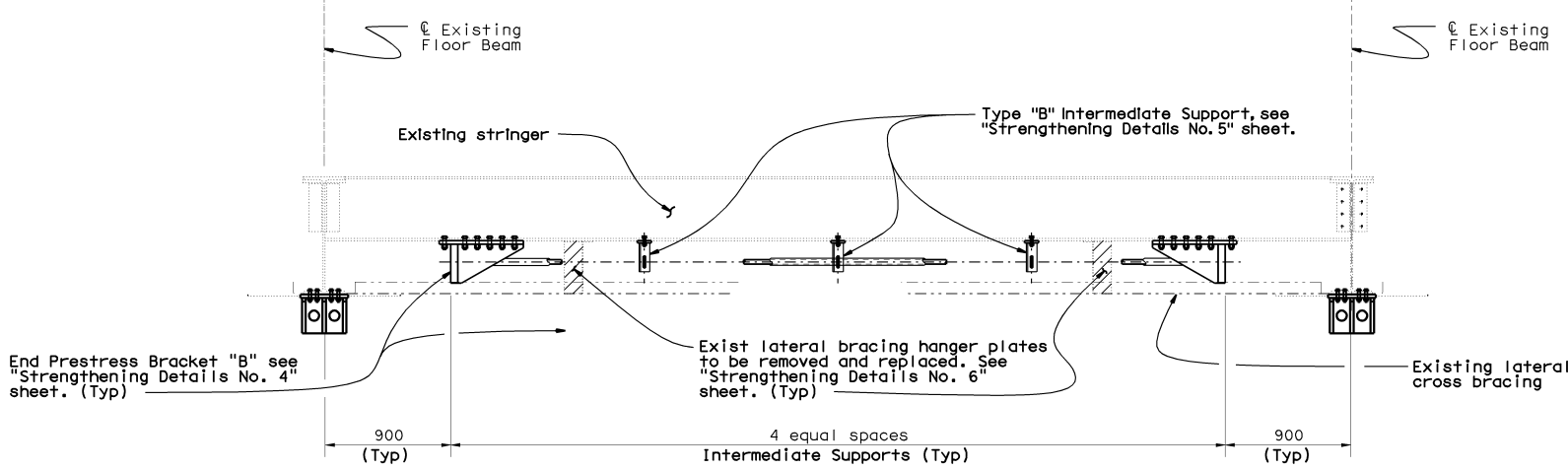
PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

REGISTERED PROFESSIONAL ENGINEER
G.S. Blakesley
No. 45509
Exp. 12-31-02
CIVIL
STATE OF CALIFORNIA



TYPICAL FLOOR BEAM SECTION
1:20



TYPICAL STRINGER ELEVATION
1:20

NOTE:
THE CONTRACTOR SHALL VERIFY ALL
CONTROLLING FIELD DIMENSIONS
BEFORE ORDERING OR FABRICATING
ANY MATERIAL.

DESIGN BY Gerrard Hight		CHECKED Greg Thornton	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	BRIDGE NO. 09-0004	BRIDGE ACROSS NORTH FORK FEATHER RIVER AT TOBIN STRENGTHENING DETAILS NO. 2
DETAILS BY Jeff Thorne		CHECKED Greg Thornton		KILOMETER POST 11.3	
QUANTITIES BY A. Bagde		CHECKED A. Ankir			

CU 02
EA 3016U1

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)					SHEET 5 OF 31
1	2	3	4	5	
11-29-99					

FILE => tobin_strengthen02.dgn

